A TREATISE ON PHOTOGRAVURE

HERBERT DENISON F.R.P.S

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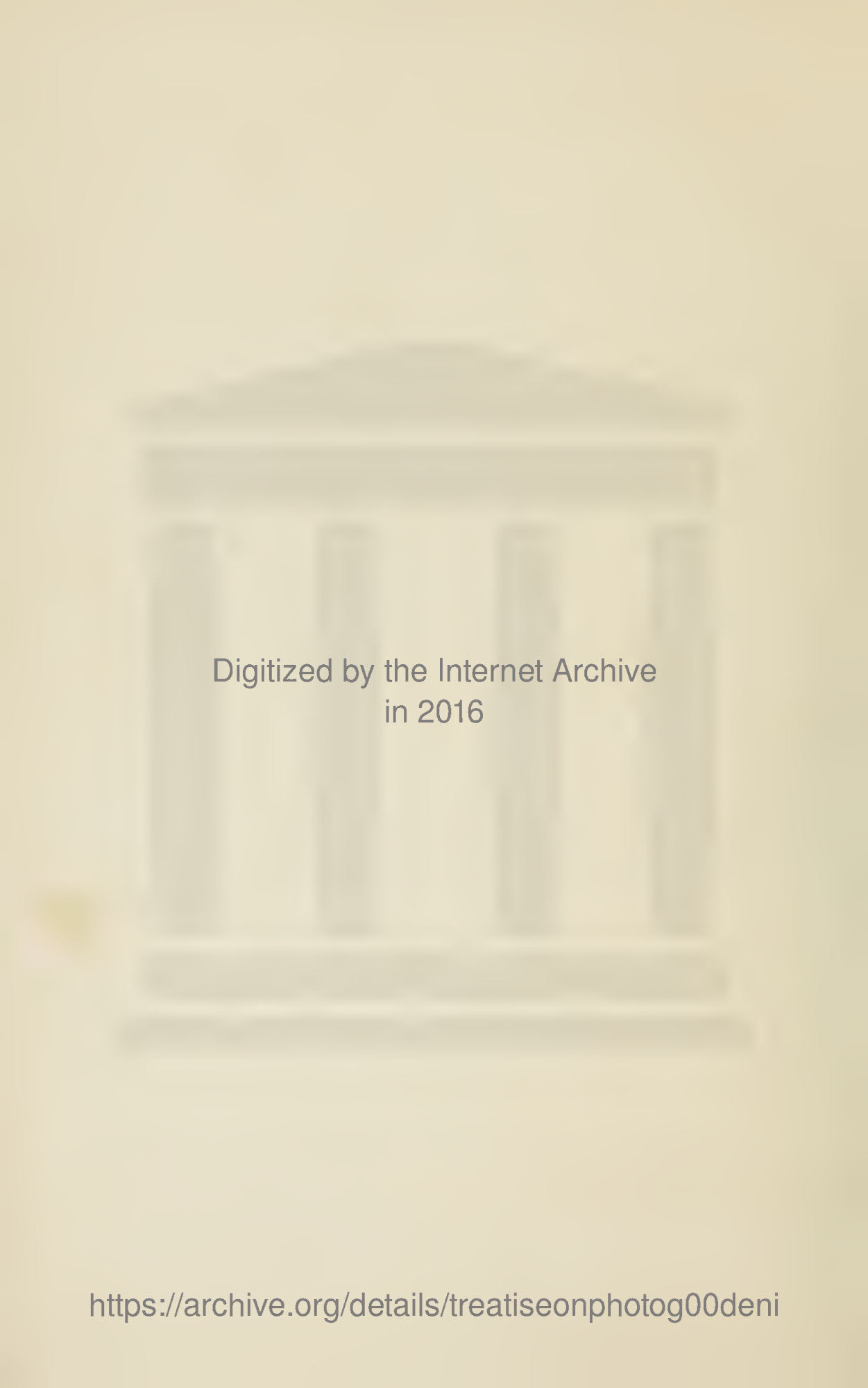
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A TREATISE

ON

PHOTOGRAVURE

IN INTAGLIO BY THE TALBOT-KLIC PROCESS.

BY

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PREFACE.

THE rapid growth in importance of photogravure in intaglio, both in art and as an industry, together with the paucity of information on the subject contained in a convenient form, afford sufficient apology for the publication of this treatise.

The practical details and directions herein contained are the result of considerable experience and experiment, and the author trusts that his labours may enable many who are now strangers to the process to experience some of the pleasures enjoyed by himself in becoming intimately acquainted with its resources.

The author is indebted to Mr. Thos. Bolas, F.C.S., F.I.C., for the historical notes contained in Chapter XIV.

H. D.

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CHAPTER I.

INTRODUCTORY.

Nature of photogravure plate.

A photogravure plate is one of metal, preferably of copper, which bears on its surface in intaglio an etched representation of the subject to be reproduced. In other words, the portions of the plate representing the shadows and half-tones of the subject are sunk, instead of being the highest points—as in the case of half-tone and other blocks intended for use in ordinary letterpress printing—and the portions representing the high lights of the subject still retain the original level and surface of the plate.

This intaglio state of the plate is the result of the action of a mordant or etching fluid upon the metal, whereby the latter is etched or eaten away wherever the mordant comes in contact with it.

Process partially mechanical.

As the name given to the process indicates, in photogravure the etching of the metal is controlled by photographic

means, and the process is therefore a mechanical one, to some extent at least, as distinguished from an "etching," properly so-called, and, because of its more or less mechanical nature, photogravure has been severely decried by the supporters of other intaglio methods of producing pictures.

Original work from nature.

With regard to original work, a print from a photogravure plate is open to the same criticism as a print direct from the negative, which is its foundation; and this, notwithstanding that the former is widely separated in its characteristics from a print by any purely photographic process. But it appears only reasonable to contend that in passing judgment on a picture the method of its production should be left entirely out of consideration, and that the visible result, and that only, should be regarded. After all, the true value of a picture is as a means of decoration, and the fact that in a photographic picture use has been made of the action of light should not detract from its value any more than does the fact that a painter also avails himself of the resources of nature in using the pigments that go to make his picture.

Reproduction by photogravure.

In the reproduction of paintings and drawings, however, photogravure stands on a different footing. The object here is to produce the most truthful and accurate reproduction possible of the original. As to accuracy of outline, there can be no serious contention that the engraver surpasses the lens; and in interpretation, photogravure has a distinct advantage over the engraver, in employing half-tone, instead of line, to reproduce a half-tone picture; and if photography is not yet quite equal to rendering with absolute truth the entire range of colours found in a picture, this difficulty can be overcome by handwork on the negative, supplemented by corrections on the copper.

Truth in reproduction

The mechanical nature of photogravure is distinctly in its favour for reproductive purposes; there is no opportunity for the individuality of the engraver to leave an impress on the print antagonistic to that of the painter. It is the work of the painter in its entirety that the reproduction should portray—not a portion only of his work contaminated with the style and mannerisms of another, in whom, possibly, the possessor of the reproduction has no interest. The

great increase within recent years in the number of photogravure reproductions of pictures proves that these advantages are appreciated by painter-artists.

Outline of general intaglio methods.

It will probably lead to a better understanding of the photogravure process if the essentials common to plates by that process and to all intaglio plates are first considered, with the assistance of an outline of the methods of production of the chief varieties of such plates. These are three, namely—engravings, etchings, and mezzotints.

Engraving.

An engraving, as distinguished from an etching (for the term equally applies to an etching in so far as the image is in both varieties *engraven* on the metal by removal of a portion of its surface), is produced by the removal or digging out of portions of the metal—whether copper or steel—in lines or dots (stipple). The tool employed is a burin, consisting of a thin steel rod fastened into a wooden handle, round in shape, but with a flattened side, the cutting end of the tool being ground off flat at an angle of about 40°. With the handle held in the palm, the flat side being downwards, the burin is pushed along the plate, ploughing its way through and removing the metal in its progress.

The result is governed by the form of the incision, whether straight or curved, its depth, and the proximity of one line or dot to another. The shape of the incision can be further varied by the use of burins made from steel rods of different sections.

Etching.

An etching differs from an engraving in that the removal of the metal is the result of the corrosive action of a mordant in place of the mechanical action of the burin. The plate is entirely covered with an "etching ground," impervious to acids, composed of wax with certain ingredients added to render it less brittle. The subject is then drawn upon the plate with needles of varying fineness, which, in their transit, remove the etching ground, and so lay bare the metal to the action of the mordant.

When the drawing is complete the plate is immersed in a weak etching bath, composed of an acid diluted with water, and as the etching proceeds the plate is removed from time to time, rinsed and dried, and then the portions which have been sufficiently bitten are stopped out with varnish. This done, the plate is re-immersed, and the etching proceeds until it is necessary again to stop out, and so on until the

darkest lines are sufficiently deep. The wax is then removed, and the plate is ready to be printed from.

Mezzotint engraving.

Mezzotint engravings differ considerably from the foregoing varieties. The plate is first roughened over its entire surface by being rocked to and fro in various directions with a steel tool somewhat resembling the rocker of a cradle in appearance, and having its convex edge serrated. These saw-like teeth on the edge of the rocker indent the plate, and as the metal is not removed, but displaced only, it rises slightly round each indentation, thus increasing its depth, and producing what is known technically as a "burr."

A plate, if properly rocked, would, if printed at this stage, yield a perfectly black impression. The picture is produced by removing with a scraper both burr and indentations where the whites of the subject are to be, removing them partially only, and to a greater or less degree for the half-tones, and leaving the plate untouched in the darkest portions of the picture.

From subsequent descriptions, it will be seen that a mezzotint plate more closely resembles one produced by photogravure than either of the others previously described.

Printing intaglio plates.

In the case of all intaglio plates, the method of printing is by filling the depressions with a stiff fatty ink of a special nature, and afterwards removing the ink from the surface only by means of muslins of different qualities, the final polish to the high lights being given by the hand.

The plate is laid on the iron bed of a copper-plate press, a piece of plate paper quite limp with moisture is placed on the top, with three or four pieces of blanketing on the paper, and the whole is passed through the rollers. The pressure, aided by the yielding nature of the blanket, forces the paper into the depressions of the plate where it comes into contact with the ink, and on raising the paper from the plate, the former will be found to have licked up the ink, and retained it on its surface. The paper and ink together in reality form a cast of the subject depicted on the plate.

Essentials of intaglio plates.

From this brief outline (the subject of printing will be more fully dealt with hereafter) it will be readily understood that in order that the ink, in the process of cleaning the surface or "wiping," may not be removed from the depressions as well as the surface of the plate, it is essential that it

should be confined in spaces not so large as to permit of the muslin sinking into them during its passage over the plate. In etchings and engravings this confinement of the ink is natural, consequent upon the subject being expressed in line or stipple, the only thing to avoid being the running together of lines placed close together, due in etchings to the lateral action of the mordant; while in mezzotint engravings the same result is attained by the roughening of the plate, the rocker producing a cellular surface eminently suited to the retention of ink.

Difficulties in half tone intaglios.

The etching of a plate in pure half-tone (say a photograph from nature), in which the tones gradually merge one into another frequently without any perceptible step between, and where almost the entire picture is etched to some extent, would not yield a surface with this retentive quality sufficiently pronounced to truthfully render the tones of the subject. A magnified section of such a plate would simply show an undulation of surface corresponding to the depth to which the etching had been carried. It will be seen from the accompanying sketch of a section of such a plate (fig. 1) that there would be nothing to

prevent the ink being removed in the process of wiping from the whole of the etched portions of the image, except under the shoulders formed by the margins and by small patches of high-light at various points of the subject. This difficulty was met with

FIG. 1.

AA. The original surface level of the plate. B. The etched portion.

by all the early workers, who found that, although the roughness of the metal resulting from the action of the mordant enabled light tones to be rendered correctly, it was insufficient to retain the necessary amount of ink to produce dark tones.

W. H. Fox Talbot.

The difficulty was to some extent surmounted by Fox Talbot, by applying a resinous dust to the surface of the gelatine resist; but this was in connection with the process in which the plate to be engraved is coated with the bichromatised gelatine, exposed behind the transparency, and etched without washing out the soluble gelatine.

Klic's invention.

It is to Klic that we are indebted for the idea of protecting the metal, before the transfer thereto of the resist, by an acid-resisting gum distributed evenly over its surface in the form of fine particles, which

are caused to adhere to the plate by heat. This ground, while protecting the metal, also afforded a surface which would retain in position a gelatine resist produced by the carbon process, and transferred to the plate for development. Prior to this, the carbon process could not be used because the resist invariably stripped off the bright metal on drying.

Effect of grain

The effect of the grain obtained in this way is to break up the comparatively large depression, representing a flat tone in the subject, into a multitude of minute depressions or cells, each of which is divided from its neighbours by small patches or points of somewhat pyramidal form, having their bases at a depth from the surface proportionate to the darkness of tone to be reproduced, and their apices being the

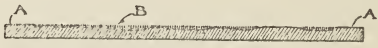


FIG. 2.

A A The original surface level of the plate. B. The etched portion protected by the ground.

original surface of the metal (fig. 2). The surface of the plate, after etching, will partake somewhat of the nature of a fine file, and will be found to retain the ink in its various parts exactly in proportion to the depth of the cells.

CHAPTER II.

THE NEGATIVE.

Knowledge of photography presumed.

As to the mode of production of the negative from which the photogravure plate is to be produced, whether one from nature or from a painting or drawing, it does not appear necessary in a work dealing with the photogravure process to enter into details. Anyone unfamiliar with photography, and desiring to work in photogravure, must necessarily master the first subject before attempting the second, and for this such a reader is referred to the many excellent text-books on the processes of pure photography. In this work, therefore, it will be assumed that the reader is acquainted with the practice of photography, at least up to and including the making of the negative.

Character of half-tone negative.

However produced, whether by the wet-plate process or by gelatino-bromide, it should possess a good scale of gradation and be fairly strong, though not hard, with plenty of detail; though any negative that

will yield a transparency which is satisfactory in point of gradation is suitable for photogravure.

The amount of detail in a picture is a question for individual taste. There will, however, be a slight loss of detail in the process, consequent upon the "resist," which determines the character of the plate, being a reproduction from a reproduction. And it is a generally accepted fact that in no photographic process is all the delicacy of the original negative quite reproduced in the print. The effect produced in photogravure might, perhaps, be better described as the subjection rather than obliteration of detail, the photogravure on comparison with a silver or platinum print from the original negative giving one the idea of a broader treatment of the subject.

CHAPTER III.

THE TRANSPARENCY.

Production of the transparency.

The first step in the process proper is the production of a reversed transparency from the negative selected for reproduction, and this may be produced in several ways.

In the camera reversal necessary

If there is to be any enlargement or reduction in size it will be necessary to produce the transparency in the camera by copying the negative; and it should be remembered that the transparency must be reversed, that is, when looking at the *film* side the true right hand of the picture should be on the left, and *vice versâ*. In an ordinary window transparency the picture is *correctly* viewed from the film side.

A moment's consideration will show the reason for this reversal. The next step is to obtain a print from this transparency on carbon tissue. This would bring it to its correct position, but as it is turned over on to the copper plate for the purpose of development, when developed it will occupy the same position with regard to right and left hand as the transparency

did on its glass plate. The method of printing from a copper plate again reverses the subject; there being thus an uneven number of reproductions (three) between the transparency and the print, if the latter is to be right it is necessary that the transparency should be reversed.

Methods available.

If the reproduction is required of the same size as the original negative, there are then four modes available for the production of the transparency—wet collodion, gelatino-bromide, collodio-bromide, and the carbon process. By the first method, however, it is necessary to make the transparency in the camera, and by the second and third the same necessity arises, unless a reversed negative is used, whereas in the carbon process the transparency is in the ordinary course reversed by being developed on glass.

Carbon most convenient.

The carbon process is convenient for the production of the transparency, not only because it yields naturally the *reversed* transparency desired, but also because it produces in the simplest manner the exact class of image most suitable for its purpose. And as, for the production of the resist, it is absolutely necessary that the worker should use it, the writer proposes to deal

with the carbon process to the exclusion of the others, merely remarking with regard to them that the transparency should be made to resemble one in carbon as closely as possible.

Point of chief importance.

A point of great importance in the production of the transparency is to preserve as closely as possible the exact scale of gradation which obtains in the negative, and the carbon process lends itself readily to this end. It should be as thin as possible consistent with the preservation of its scale of gradation—that is, provided detail is present in the high lights, any increase of density in the transparency is not only unnecessary, but undesirable.

Character of transparency

The principle upon which the carbon process depends is that gelatine, or any soluble organic body, if treated with bichromate of potassium, becomes sensitive to light, in so far that the action of the light renders the gelatine insoluble.

Carbon tissue.

Carbon tissue consists of a stout paper coated with a film of gelatine, with which is incorporated a pigment, and has long been an article of commerce. The practical difficulties in its manufacture are not such as need deter any photographer from

preparing his own, but it is somewhat troublesome, and the quantity used in photogravure is so small that it is recommended to purchase it rather than make it for one's self.

How tissue is sensitised.

The tissue is sensitised by being immersed in a bath of bichromate of potassium in an aqueous solution, dried, and exposed beneath the negative.

Effect to exposure of light.

Exposure to light renders the gelatine insoluble to a greater or less depth in proportion to the amount of light which the negative has allowed to pass through it, and on being developed it will be found, if the exposure has not been carried so far as to do more than just render insoluble the entire thickness of gelatine, that the gradation of the negative is accurately preserved throughout all the tones. Of course, if the exposure is prolonged after the light has completed its action on the shadows, so that it can have no further effect at that point, the gradation of the transparency will then be altered by the fact that the action of the light is still going on in the high-lights and half-tones, while it is at a standstill in the shadows. The tissue sold as "special transparency" tissue is most suitable for

Kind of tissue.

transparencies, as it contains a large proportion of pigment, and that in an extremely fine state of division.

Sensitising bath.

The sensitising bath is prepared in the following manner: Take a wide-mouthed vessel of known capacity, fill it with clean hot water, and tie loosely over its mouth a piece of fine muslin in such a way that it forms a bag reaching into the water. Into this bag place bichromate of potassium in the proportion of three ounces to a hundred ounces of water. After the bichromate has completely dissolved, liquid ammonia should be added to the solution gradually until it distinctly smells of the ammonia. A solution of the double salt of potassium and ammonium is thus produced, which has been found to give better results than the bichromate of potassium alone.

The muslin may be allowed to remain over the mouth of the vessel, as it acts as a strainer when pouring the solution back after sensitising; any foreign matter may be removed by occasionally washing the muslin.

Sensitising the tissue.

To sensitise tissue, this solution is placed in a somewhat deep porcelain dish, a little larger in size than the piece of tissue to be sensitised. The temperature of the

sensitising bath must be kept low, say not higher than 60°F., otherwise the gelatine will dissolve instead of merely absorbing moisture. The tissue is immersed in the solution with the gelatine surface upwards, and with a broad camel-hair brush any air-bubbles are quickly removed, and the tissue is then turned over on its face, and the back of the paper likewise brushed over.

The immersion should continue for three minutes, and it is convenient to use an egg-boiler as a guide in this operation, inverting the sand-glass when the immersion is complete, and removing the tissue from the bath when the sand has run out. This length of immersion need not, however, be rigidly adhered to, as by sensitising for a longer or shorter time considerable variation in the character of the tissue may be obtained. Thus, an immersion of three minutes tends to give a quickly printing tissue yielding an average transparency. An immersion of two minutes will yield a tissue producing greater contrast, but requiring longer exposure; while more than three minutes in the sensitising bath will give a quick tissue with less contrast, and the same effect may be obtained by varying

the strength of the bichromate solution, a weak bath giving a slower tissue and greater contrasts, and a strong bath giving a quicker tissue and flatter prints. It is not desirable, however, to vary the strength more than one or two per cent.

Drying tissue after sensitising

After sensitising, it is necessary to dry the tissue, and it is important that this operation should take as short a time as possible, consistent with not raising the temperature of the room in which it is drying to such an extent as to cause the gelatine to dissolve. The piece of tissue, on being taken from the bath, should be laid face downwards on a clean glass or zinc plate, and squeegeed. The squeegee consists of a thin piece of wood, into the edge of which a strip of strong sheet india-rubber has been fastened. The rubber portion of the squeegee is passed over the back of the tissue quickly, and with only slight pressure. One stroke in each direction will suffice to deprive the tissue of a considerable portion of its moisture, and too much time must not be taken up by the squeegeeing, or the tissue will be difficult to remove from the plate. To dry the tissue upon, after stripping from the plate,

Drying cards

sheets of cardboard should be provided, somewhat larger than the tissue, and bent into semi-circular form. A slit is cut in each end of the card, and a short piece of string, with a knot at each end, slipped into the slits, prevents the card flattening out. The tissue is placed face upwards on pieces of absorbent paper laid on the arched backs of the cards, which can then be suspended on strings to dry. A little more troublesome, but better, plan is to squeegee the tissue after sensitising on to glass or ferrotype plates, and allow it to remain there until dry. The gelatine surface is by this means protected from dust while drying, and a more even surface is obtained, ensuring closer contact between tissue and negative in printing. If glass plates are used, great care must be taken that they are perfectly clean, and the surface must be dusted with talc, otherwise the tissue will not strip when dry. Ferrotype plates require no previous preparation beyond sponging over. If the tissue is to be dried on a support, the squeegeeing must be more carefully done to ensure the removal of air-bubbles, first beginning at the middle and squeegeeing the right-hand half, and

Glass and ferrotype plates.

Squeegeeing.

then changing hands and squeegeeing the left-hand half, beginning a little past the middle. By this method any air-bubbles present are removed by the nearest way, without having to travel the entire length of the tissue.

Carbon tissue is practically insensitive to light while wet, and the sensitising may, therefore, be carried out in an ordinary room. But from the drying room actinic light must be excluded, and if this cannot be arranged, or even if it can, it will be found very convenient to employ a drying cupboard in which the tissue may be placed.

Drying cupboard

This can be spimly a large box, having a hole at the top and bottom through which an iron or tin pipe may pass for the whole of its height, and project out into the room both above and below. Holes are pierced in the top and bottom of the box, and screened against the entry of light. If an oil lamp be placed so that its chimney passes a little way up the iron pipe, the latter will be heated during its whole length, and will maintain a temperature inside the box at a point very suitable for drying the tissue, and the

perforations in the top and bottom will supply the necessary current of air.

The accompanying (fig. 3) sketch shows an effective, though somewhat more elaborate, form of cupboard.

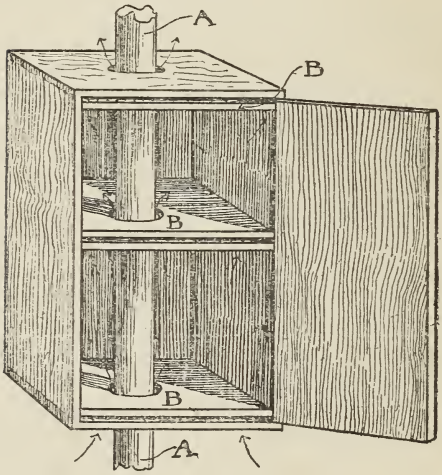


FIG. 3.

A. Tin or iron pipe. B. False floors, fitting closely at the outer edges, but loosely round A. The true floors fit closely round A, but are perforated for passage of air round the outer edges. The arrows show the direction of the air current.

Such a drying box will dry tissue that has been squeegeed on to ferrotype plates in about six hours, and the tissue will be

found to work well and to keep better than tissue which has taken longer to dry.

Masking the negative.

The tissue being dry, the negative should be prepared for printing by providing what is known in carbon printing as a "safe edge"; that is, strips of opaque paper of about one-eighth of an inch wide are fastened round the margin of the negative in order that an edging of soluble gelatine may surround the transparency. This is necessary to prevent the film washing up on development, as the unexposed gelatine adheres more firmly to the support than that which has been rendered insoluble by the action of light. Pencil lines should be drawn on the mask as guides to enable the tissue to be placed accurately on the negative.

No visible effect on exposure.

Exposure to light has no visible effect on carbon tissue, consequently it is necessary that the time during which the exposure is to continue should be determined by other than the usual means. The visible action of light on albumenised silver paper has been found to proceed at about the same rate as its invisible action on carbon tissue, or perhaps it would be more accurate to say that the ratio of speed between silver paper and carbon tissue is fairly constant. And

Use of silver paper as guide.

it is the universal practice to expose along with the carbon tissue a piece of silver paper in an actinometer of one form or another, so that by observing the darkening of the silver paper the printing of the tissue may be accurately regulated.

Actinometers

There are a number of actinometers of different form on the market; perhaps the simplest is that known as Johnson's, which consists of a small box about an inch and a half square, having a circle of yellow glass in the lid, into which is fixed a piece of cardboard of the colour which silver paper assumes when three parts exposed. There is a narrow slit in this card, through which the light may reach the silver paper, a roll of which is contained in the body of the box. When the paper beneath the slit becomes of the same colour as the surrounding card, the instrument is said to have registered one tint, and the operation can be repeated by drawing forward more paper from the roll until a fresh piece is exposed beneath the slit, and so on.

Johnson's.

A more elaborate and better arrangement for our purpose is Sawyer's actinometer (fig. 4). This is an oblong box, having in its lid a strip of glass upon which has been

Sawyer's.

printed a series of nine tints in carbon. The tints are numbered, and increase in opacity from one to nine. A roll of sensitive silver paper is contained in the body of the box, and a portion of it is drawn off, so that it comes beneath the scale. Down each side of the sensitive paper is a colour guide, and as the sensitive paper under a given

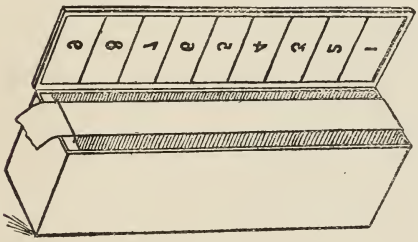


FIG. 4.

section of the scale reaches the colour of the side slip, the instrument is said to register one, two, or more tints according to the number borne by the section. The advantage of this actinometer is that the whole nine tints may be printed without having to draw out fresh paper. In the Johnson actinometer it is very easy for error to creep in through neglect to draw

forward a fresh piece of paper at the exact moment when the tint is reached.

It will be found quite simple after a little practice to determine how many tints will require to be registered by the actinometer before a given negative is sufficiently exposed. The average exposure will be found to be between six and nine tints on Sawyer's instrument.

Development: Glass plates as supports.

For development it is necessary to use glass plates as a support, and these should be prepared by coating one side with a solution of gelatine containing bichromate of potassium, and afterwards allowing them to dry in a strong light. The gelatine solution is prepared by taking a quantity of Nelson's photographic gelatine, and placing it in a wide-mouthed bottle with sufficient water to cover it; it is allowed to swell, and the temperature is then raised by means of a water bath until the gelatine dissolves. Sufficient bichromate of potash is then added to give it a lemon colour, and the solution is filtered to remove foreign matter. The plate is flowed over with this solution while hot, and it will be found to assist the operation if the plate is dipped in hot water and coated while still wet. This bichromated

Substratum.

gelatine will keep for a considerable time if protected from the air.

Soaking printed tissue.

The tissue, after exposure under the negative, is immersed in cold water in a dish, which already contains one of the gelatinised plates prepared side upwards. The tissue is immersed with the gelatine side upwards, and all air-bubbles are carefully removed from its surface with a soft brush. This being done, the tissue is turned over, and the paper side freed from bubbles also. When the tendency in the tissue to curl film inwards has ceased, and it begins to flatten out, the tissue and plate should be brought into contact under water, and removed together to a level surface, which may be either a table or a squeegee board covered with thin sheet zinc, and there squeegeed into close contact as before described. The surplus moisture is removed from the back of the tissue with absorbent paper, and the plate set aside in a horizontal position for about ten minutes, though a longer time will not do any harm.

Squeegeeing in contact.

Developing tank.

The development of the tissue should be carried on in a deep tin or zinc vessel of considerable size, which should be filled to about one-third of its depth with water at a

Temperature of water.

temperature of about 100° Fahrenheit. After a short immersion in this, the pigment will be seen oozing out from beneath the edges of the paper backing, and the latter may be removed by lifting up one corner, and drawing it back (under water) steadily from the gelatine, which will remain adhering to the glass plate. The warm water should now be quickly dashed over the surface to remove any bubbles which may be present, and then the plate may be allowed to soak for a few minutes to soften the gelatine, while the next plate is proceeded with.

By laving the plate with warm water applied by the hand, in the course of a few minutes the whole of the soluble gelatine will be removed from the plate, leaving a transparency consisting of pigmented gelatine, which has been rendered insoluble by the action of light.

Over-exposure.

If, on examination, the transparency should be found over-exposed, the temperature of the water may be raised up to 120° F., or the addition of a little bicarbonate of soda to the water used for developing will enable development to be carried further. A transparency which is

Under-exposure.

too thin—though this does not often occur

with the special transparency tissue—may be intensified by staining it in a solution of permanganate of potash, and rinsing under the tap until the desired degree of intensity is obtained.

Alum.

On completion of development, the plate should receive a final rinse in cold water, and be soaked in a five per cent. solution of alum for a few minutes, to remove the last traces of bichromate, and again rinsed and set aside to dry.

Subsequent treatment. Retouching

It is then in a condition to be varnished, finished, and worked upon in the same manner as a transparency on a gelatino-bromide plate.

Hard negatives.

In working from a hard negative, or one in which the contrasts are too great, it is sometimes an advantage to employ ordinary tissue instead of the special transparency. That known as "standard brown" will generally be found the most suitable, and the manipulations in the production of the transparency are, of course, the same.

CHAPTER IV.

THE GELATINE RESIST.

The resist.

We now come to the preparation of the gelatine film, by means of which the actual etching of the plate is to be regulated. This consists simply of a print from the transparency on carbon tissue, which is transferred for development to the copper plate. The development of this print will result in a film of gelatine of varying thickness extending over the whole of the plate, and it is this variation in thickness which regulates the etching, it being readily understood that, apart from other considerations, it would take longer for the mordant to penetrate and reach the copper through a thick film than through a thinner one. The dark tones of the subject being represented by only a thin film of gelatine, the plate will be attacked there first, with the result that the etching will be deeper than in another tone, where the etching only commences a minute or two afterwards.

Its nature

Effect of resist in etching.

Tissue for the resist.

The carbon tissue to be used for the resist need not be anything like so heavily

charged with pigment as the tissue for the transparency, the pigment playing no part in the result beyond enabling the operator to see before he begins etching whether or not he has got a correctly-exposed print. At one time it was customary to use "standard brown" tissue almost exclusively for the resist. But as the progress of the etching has to be observed through the tissue (the etching as it proceeds darkening the copper), unless the film was a thin one all over, it became very difficult to see exactly what was going on. There is, however, now on the market a carbon tissue made by the Autotype Co. expressly for photogravure resists. It is made in two colours, red and brown. In each case the tissue is but lightly pigmented; in fact, it has the appearance rather of a stained gelatine than one to which pigment has been added. Both colours may be relied upon; the red, being the lighter colour, permits of the etching being watched with less effort; but the brown more readily enables the operator to judge whether or not the exposure has been correct, as the colour of the red tissue, when seen in a very thin film, is practically only yellow, and very slightly contrasts with the copper plate

'Standard brown" tissue.

"Autogravure tissue.

to which it is attached. Practice will in either case enable work to be judged with certainty, but it is desirable to select one of the two kinds, and adhere to it, rather than change about from one colour to the other.

Sensitising the resist tissue.

The sensitising of the tissue for the resist is the same as for the transparency, and it is well to dry the tissue on the glass or ferrotype plates as before described, in order to avoid dust falling on the surface. This is more important when dealing with the resist tissue than in the case of the tissue for the transparency, because any little pinholes or other marks can, in the transparency, be retouched, but such defects cannot be remedied in the resist without using varnish, which prevents the etching entirely, and leaves a blank spot on the etched plate, which would have to be filled in by hand. The tissue, being perfectly dry, can readily be separated from the ferrotype plates by raising one corner with the point of a penknife, and it will be found to possess a brilliant, even surface.

Masking

It is necessary in printing from the transparency, as from the negative, to mask the subject round with strips of opaque paper, and care should be taken that the sides are

kept parallel, and the angles right angles; and as it is necessary that the piece of tissue should be larger than the opening in the mask, pencil lines must be drawn on the top and left-hand side of the mask one-eighth of an inch from the inner edge. The angle made by these two lines must be kept perfectly true, otherwise it will be impossible to ensure that the subject occupies the exact position required on the copper. If a slight error has been made in masking the subject, it can, within certain limits, be rectified when drawing these lines on the mask. Guide lines.

The size of the transparency between the inner edges of the mask should be carefully measured, adding a quarter of an inch for the safe edge to each dimension, and the piece of tissue must then be cut exactly to size. If this has been properly done, it will be found that, upon placing the tissue on the transparency with the end and one side close to the lines on the mask, the tissue will extend on all sides one-eighth of an inch beyond the mask opening.

A printing frame with pressure screws, instead of the ordinary springs, is the best to use, and it should be furnished with a plate glass front and a sheet of soft rubber to Printing frame.

place over the tissue. The mask being on the film side of the transparency, soft packing and considerable pressure are necessary to secure proper contact between the tissue and the transparency.

The printing frame, containing the transparency with the tissue behind it, is placed in diffused light, and the exposure made, the actinometer being exposed at the same time, and care being taken that the same amount of light falls upon both the printing frame and the actinometer. The Sawyer actinometer will do for this purpose, but, as the exposure is considerably less than is required for the transparency, this instrument is scarcely so sensitive as might be desired. A more delicate instrument is known as the Woodbury photometer, which is an arrangement of a series of tints round a circular opening, beneath which is a piece of sensitised silver paper. Nothing but plain glass comes between the paper and the light, so that the tint is more quickly obtained. Really, no specially-made actinometer is needed. The operator can easily, with water or oil colour, or by the carbon process, make for himself a standard tint, and by exposing a slip of silver paper

Woodbury photometer.

alongside the standard tint in a frame, the exposure can be quite accurately gauged. For a medium transparency, it will be found that when the silver paper has reached its darkest shade before bronzing, the resist will be fully exposed.

Length of exposure.

There is always some uncertainty, if the transparency is being printed from for the first time, as to whether or not the correct exposure has been given, and as it is of supreme importance that the resist film shall be perfect—neither over-exposed, which would give too thick a resist, nor under-exposed, which would result in absence of detail in the shadows—it is advisable to use the first print as a trial, and develop it, not upon the copper, but upon the smoothed side of a piece of opal glass. By this means (a note being, of course, made of the exposure) it can be absolutely determined whether everything is right, because, being mounted on a white surface, a yellowish-red image can be seen far more readily than would be the case if the resist were judged from its appearance on the copper.

Trial resist.

Correctness in the exposure for the resist is of the utmost importance. Although a slight error may be corrected in development

Correct exposure: its importance.

by using water at a higher or lower temperature, the latitude in this respect is not so great in the development of the resist as in the case of the transparency, because it is necessary in the resist to ensure that the image consists of insoluble gelatine only, and also because extremely hot water, say above 120° F., has a tendency to cause the film to strip off the plate on drying. The operator's aim should therefore be to give such an exposure as will allow of the resist being properly developed at a temperature between 100° and 120° F.

When the exposure of the trial resist is completed, the printing frame is removed into the developing room, and the development proceeds in exactly the same way as when developing the transparency.

Character of resist.

Endeavour should be made to so regulate both exposure and development as to produce the thinnest possible film consistent with full detail in the shadows. A

Resist too thick.

resist possessing an appreciable thickness of gelatine in the darkest shadows will cause the etching to be long in starting, which is always undesirable, and it may be that the first, or even the second, etching bath will have to be abandoned as incapable

of penetrating such a film at all, thus shortening the range of baths, or necessitating making up special weaker ones.

If the exposure of the trial resist is found to be correct, another piece of tissue is cut to size, placed in the frame behind the transparency, and a similar exposure given; and when that is completed it is ready for mounting on the copper plate.

CHAPTER V.

THE COPPER PLATE.

Quality and surface

The quality and surface of the copper plate are very important matters. The copper should be as pure as can be obtained, and its surface should be highly polished and quite free from scratches. The best copper is, I believe, known as of high conductivity, which, I suppose, merely indicates that care has been taken in its manufacture to eliminate foreign substances. The thickness of the copper I need say very little about. If the manufacturers are informed that the plates are to be printed from direct, they will usually see that the thickness of the plate is in proper proportion to its size. As ordinarily sold, copper plates have almost square edges, and before printing it is necessary to bevel them, in order to prevent the paper being cut. In this process there is always some risk of the plate being scratched, and if the plate has already been etched, when this is done, the scratches may be very difficult

Bevelled edges.

to remove without injuring the picture. The cost of bevelling is not great, and I recommend that the plates should be ordered bevelled to begin with. When the plates are received from the manufacturer, they should be perfect in surface, and if scratches or other defects appear on the surface, it is better to return the plates, and obtain perfect ones, as it is not an easy thing to patch up a plate, and produce again a polish equal to the one the makers can offer.

Scratches.

If, however, the defects are only small and shallow, they can be removed by the use of a burnisher, which can be obtained in various shapes and curves, and is in the form of a steel rod, with a highly-polished surface from its blunt point to the handle in which it is set. In removing a scratch, the burnisher should be held in the right hand, with the scratch running away from the operator, and, beginning at one end of the scratch, the plate is gently rubbed with the burnisher, moistened in the mouth, or with a little oil, until the soft copper is made to fill up the depression, and so the burnishing is continued gradually right up from one end of the scratch to the other. If the defect is a small pit in the plate, it may be left alone

if it will come in a dark part of the subject, but, if not, the only remedy is to remove the copper with a scraper for a little distance all round the hole until the pit disappears, and then the marks of the scraper are burnished out as before described. This will produce a depression in the plate, but it will not be so sudden a depression as at first, and will not hold ink in printing.

Cleaning the plate

When the surface is quite perfect, the next step is to thoroughly clean it, with a view to removing all grease and tarnish from the surface. It is placed on the table with a piece of paper considerably larger than itself beneath it, so that the plate may be isolated from all dust and other foreign matter, and with a little pad of cotton-wool it is first treated

American potash.

with a solution of American potash, strength unimportant—this is a very powerful alkali, and must be handled with care, as it has a solvent effect on the skin. The potash is rinsed off under the tap, and a fresh piece of cotton-wool is moistened with

Sulphuric acid.

sulphuric acid, of a strength of one part to twenty of water; the first will remove the grease, the second the tarnish. The plate is again rinsed, and with another pad of

cotton-wool its surface is gently rubbed with a circular motion with a paste composed of double-washed whiting moistened with a three per cent. solution of ammonia. This should be continued until, on rinsing the plate, the water is found to run off evenly, and not stand in drops on its surface. The plate may then be dried with a clean linen cloth. This will be facilitated if the last rinsing of the plate has been in hot water. The plate is now ready to receive the bitumen ground, which will be treated of in the next chapter.

Washed whiting.

CHAPTER VI.

THE GROUND.

Function of the ground.

The function of the ground is, as already explained, to give to the plate the tooth necessary to enable it to hold the ink in printing. This being so, any means by which the copper can be protected at minute points by a substance impervious to the action of the mordant will answer the purpose. The two broad divisions of dusts and liquids suggest themselves. In the case of dust, its particles must be evenly scattered over the surface of the plate, and they must be capable of being attached to the plate by some means or other. Liquids may be either sprayed on to the plate, or the ground may be the result of the reticulation of a liquid flowed over the plate. I refer to liquid grounds more by way of suggestion of possible methods rather than as methods which I recommend for ordinary use. The dust ground is very rapidly laid, and appears to be eminently

Dust and liquid grounds.

satisfactory. For special purposes, however, it may be desirable to use other methods, and outlines of the principal ones will therefore be given.

Liquid ground: Resin or bitumen.

For use with the spray a solution of resin, or bitumen, and many other gums in benzole or ether, may be used, the solution being contained in a bottle into the cork of which a scent spray is fixed. The construction of this little appliance will be familiar to most of my readers; it may be actuated by the breath, or by a pneumatic ball and tube. If the spray is in good order, the size of the globules of moisture may be governed to a considerable extent by bringing the plate nearer to or removing it further away from the operator. To produce a fine spray, vigorous blowing will be required. When the plate has been sufficiently covered it should be set aside for the solvent to evaporate. If a strong ground is required it will probably be desirable to spray it two or three times, allowing the solvent to evaporate between the applications in order to prevent the globules running together. When quite dry, if the operations have been properly performed, the plate should be practically in the same condition

Scent spray

as a plate grained with dust after the dust has been fixed to the plate.

Air-brush

The air-brush promises to afford a very excellent means of distributing liquid grounds; enabling, as it does, the operator to vary the coarseness of the deposit at will. This is a very important point in which dust-grounding is deficient. In theory, and to a considerable extent also in practice, the coarseness of the ground should vary in the different portions of the subject in the same ratio as the depth of etching required, and it is not possible to obtain this in the dusting box.

With dust ground.

The air-brush might be usefully employed in conjunction with the dust ground by spraying a liquid ground on the parts of the subject requiring greater strength after mounting and drying the resist. The visible image would enable this to be done with great accuracy.

Reticulated ground.

For a reticulated ground the old aquatint engraving formula may be used. Make a saturated solution of resin in rectified spirits of wine, which must be quite free from water. It will take two or three days to obtain complete saturation, and the bottle should be shaken occasionally. In

another bottle take two ounces of spirit, and add to it half an ounce of the resin solution, and flow the clean copper plate with it as though one were varnishing a negative, and set aside in a horizontal position for the spirit to evaporate.

If, when dry, the ground is not of the character desired, it must be cleaned off, and the plate flowed afresh with the resin solution, after varying the proportions of resin and spirit, increasing the quantity of resin to obtain coarseness, and adding spirit to obtain a finer grain. The addition of a few drops of methyl ether or benzine tends, I think, to improve the character of the grain.

The advantage in the use of liquid grounds seems to lie in their not requiring special apparatus, while the dust ground, on the contrary, necessitates the making of a special box, but the cost is not great, and I consider the dust ground more under control, and more reliable for general purposes.

Dust is the principal difficulty to contend with in laying a liquid ground; it interrupts the regularity of the reticulation, and it is

very difficult to protect the plate from it while the resin is being applied.

Dusting box.

The apparatus for laying a dust ground consists of a rectangular box (fig. 5) measuring on the base 18in. square, and in height 2ft. 6in. The size, of course, must depend on the size of plate intended to be grained; the box illustrated is intended for plates up to 12 x 10, but, whatever reductions are made in the size of the base, the height of the box should not be unduly cut down, otherwise the height of the column of dust will not be found sufficient to allow of a sufficient deposit of dust on the plate without a second insertion.

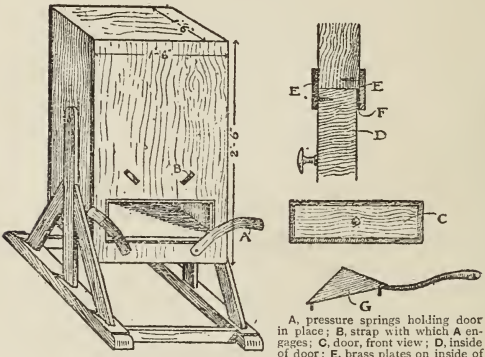
The box is supported from the middle of the sides by pivots, which allow of the box being revolved on its support. An opening is provided at the bottom of the front of the box to allow of the insertion of the plate. The box should be lined throughout with a glazed paper or thin sheet zinc, preferably the latter, as it is necessary that the inside of the box should be perfectly smooth to prevent the particles of dust sticking to it, and falling down at inconvenient times. If a zinc lining is used, it also materially assists

Glazed and damp-proof lining.

in keeping the dust from damp, which is a very desirable thing. The door is another point of great importance. It is a very difficult matter to construct a door on the usual lines, which will not allow the dust to escape while the box is being revolved. The best form of door for this purpose that I have seen is constructed as follows: Round the opening strips of brass about half an inch wide are screwed on the inside of the box to form a perfectly even surface, against which the door may be pressed, and the door, which is without hinges, is provided round the edge of its inner surface with strips a quarter of an inch wide of sheet indiarubber, so that when the door is in place, the indiarubber comes in contact all round with the plates fastened to the box. An additional protection against the escape of dust is provided in the shape of plates of brass screwed to the face of the door and projecting beyond its edges. The front of the box rises about two inches before the door opening begins, in order that the dust lying at the bottom may not fall out when the door is removed, and this lower portion of the front forms a ledge sufficient for the door to rest

Dust-tight door.

upon while the plate is receiving the ground without making use of the fastenings. When the box is being revolved, the necessary pressure to keep the door in place is obtained by a couple of strong brass springs, after the nature of the springs used in photographic printing frames. Perhaps the accompanying sketch will enable the arrangement to be better understood.



A, pressure springs holding door in place; B, strap with which A engages; C, door, front view; D, inside of door; E, brass plates on inside of box and outside of door; F, india-rubber round inside of door; G, stand on which plate is inserted in box.

FIG. 5.

The graining dust.

Almost any varnish gum may be used for the process of dusting the plate, but mixtures of two kinds of gum are to be avoided, as any difference in their melting points

may lead either to one of them not becoming fixed to the plate, or, if sufficient heat is applied to fix it, the other gum may be overheated, and the particles run together on the plate.

Ordinary resin yields a good grain when used alone, and is a favourite with French workers. Copal also may be used, but I have always given the preference to bitumen. It is very hard, and can readily be reduced to a fine powder, and the particles remain quite free, and do not stick together, as is the case with some other substances, and, if desired, the resist can, when mounted on the plate, be dried off with spirit without destroying the grain, as would be done if resin were used. Whatever gum may be decided upon, about one and a half pints will be necessary for this size of box. It should be finely ground, and, as this is a very dusty business, it will be found convenient to buy it in this form.

Bitumen.

In order to lay a ground, the box is revolved several times, the sides and top being beaten during the operation, to displace the grains of dust which may adhere thereto, and by this means a cloud of dust is raised within the box. A final beating is

Laying the ground.

given, and the box is brought to a standstill and secured in position by the peg at the side. The length of time for which the box is allowed to rest after being revolved is important in its effect on the character of the resulting grain. When the box is brought to rest, many coarse particles of dust will be in a state of suspension along with the finer ones; the former will naturally fall first, and the longer the rest is the finer will be the ground, and *vice versâ*.

Varying character of ground.

If a coarse ground is desired, the plate may be inserted after a rest of, say, twenty seconds. After about one and a half or two minutes all the coarse particles will have subsided, and very little increase in fineness of grain will be obtained by waiting longer. It naturally follows that the longer the box is allowed to rest the less dust will remain for deposit on the plate, and it may be necessary, if a very fine ground is desired, to insert the plate more than once. When the box has rested for the time decided upon, the door is removed, and the plate inserted on a stand, having supports about two inches long, which serves to keep the plate out of the dust lying at the bottom of the box (see fig. 5, G).

Unevenness of deposit.

One peculiar effect frequently observed on the plate upon removing it from the box is that, although the deposit of dust over the middle of the plate is perfectly regular, the deposit near the edges is very uneven, and it has been suggested that probably this is due to currents of air created by the particles of dust which descend close to the edge of, but not touching, the plate, causing eddies, and drawing the dust particles into irregular forms. Be this as it may, the remedy is to place the copper plate in the middle of a larger one of glass or metal, and so pass them together into the dusting box. The ground should then be found to be regular over the whole surface of the copper, and the irregularities will be upon the supporting plate alone. The length of time the plate should remain in the box depends upon the quantity of grain required, and also upon the size of the box. If the plate is inserted, say, half a minute after the box is brought to a standstill, the dust will be found to have completely settled at the end of four or five minutes, and there should then be a sufficient quantity on the plate. This can be ascertained by holding the plate near the light

Quantity of grain.

Appearance of dusted plate.

a little below the level of the eye, and in this position the dust should appear to be almost a solid coating, having the appearance of fine fawn-coloured cloth. If the deposited dust is insufficient, the box must be again revolved, and the same process repeated. For a very fine ground, in a box of rather smaller dimensions, the writer has sometimes given as many as four insertions.

Removing large particles.

If by chance any extra large particles of dust should have fallen on the plate, they may be removed with a very fine sable pencil, slightly moistened in the mouth, but great care is necessary to prevent the ground being spoilt; still it is necessary to remove them, otherwise they may pierce the gelatine resist, and cause the mordant to penetrate to the copper without undergoing the process of filtration through the gelatine resist.

The questions both of quantity and fineness of ground depend upon the character of the subject to be reproduced. A light and delicate subject will require a finer ground and one less in quantity than a subject with heavy shadows. During the etching of the image the mordant is constantly undermining the grains of bitumen,

and, to withstand this, if the etching is to be deep, the dust grains must be correspondingly large.

Fixing the ground.

When a ground that is considered correct as to both quantity and fineness has been obtained, the plate should be taken from the box and fixed by one edge in the jaws of a small hand vice, the grained surface of the plate being protected from damage by a slip of cardboard or thick paper. The plate is now held over a small gas stove of the ordinary circular form, or over a Bunsen burner, and gently moved about to obtain an even degree of heat.

Appearance of plate when ground fixed

In the case of bitumen, after a while the dust will be observed first to lose its dulness and become transparent, and afterwards to assume a bright appearance with a colour approaching steel blue, and not till then should the plate be removed from the heat. To observe this change properly the plate should be held horizontally just a little below the level of the eye, with the light coming from the front, in which position it will be readily seen when the dust has attained the right colour.

In the case of resin and copal I have not noticed this steel blue appearance, but the

Importance of sufficient heat.

dust simply becomes transparent. It is important that the plate should be sufficiently heated, otherwise the dust does not become properly attached, and affords no protection to the copper. On the other hand, if it is overheated there is a danger of the particles running together, in which case the ground would be too coarse, or in an extreme case would extend over the whole plate like a varnish. When using bitumen for the ground the heat necessary to produce the steel colour is so great that there is not much danger of overheating, but in the case of resin or copal great care should be exercised. After the plate is cool the ground can be examined with a magnifying glass, and it is still possible to increase the amount of grain, if desired, by a further dusting, followed by heating, and so on, and when cool the plate is ready to receive the gelatine resist.

CHAPTER VII.

MOUNTING AND DEVELOPING THE RESIST.

The copper plate having been properly cleaned, the ground laid in the manner indicated, and the resist printed, the copper plate is placed in a dish of clean cold water. It is desirable that the water should be filtered in order to remove any small particles which may be suspended in it, and which might get between the plate and the resist. This can readily be done through fine cotton stretched over a light framework of wood.

Filtering water.

With the same object of removing foreign matter the plate before immersion in the water should be carefully freed from all hairs and dust which may be found adhering to either the grained surface or the back. Any particles which may be imprisoned between the plate and the resist may cause mischief, either by preventing the mordant from reaching the copper, or, if they are grains of dust somewhat large and pointed, they may perforate the resist,

Avoidance of dust.

and so allow the mordant free access to the copper, which would result in deeper etching than would be the case if the mordant had first had to pass through the gelatine film.

Transfer to plate.

The plate then being in the dish of water, the exposed resist tissue is removed from the printing frame, and carefully dusted with a camel-hair brush, and immersed in the water face upward.

When removing the tissue from the printing frame, the top of the picture should be indicated by a pencil mark on the back, as a guide to placing it in position on the copper plate, as, although it is possible on first immersing the tissue to see on looking at it with the light at a certain angle something of the image owing to the different rates at which the exposed and unexposed portions absorb moisture, still it is better to have a definite mark to go by. When using red autogravure tissue, a slight image may be seen, the result of the darkening action of the light.

Size of plate.

The size of the plate for a given picture is a matter of taste, but it is customary in intaglio work to allow equal margins on the two sides and at the top, with a somewhat

larger space at the bottom to allow either of the signature of the artist or the title of the subject.

Marking position on plate.

It is possible with a lead pencil to mark the grained surface of the plate so as to show the position in which the tissue is to be placed, and it is well to do so in the case of a plate having wide margins, but where the margin at the top and sides is only about a quarter of an inch, it is quite easy to adjust the tissue upon the plate while in the water, merely using the edges as guides.

Soaking the tissue.

On first immersion in the water the tissue will curl with the gelatine side inwards, and at this stage a clean camel-hair brush should be passed over the gelatine surface in order to remove air-bells, and the tissue is then turned over on its face, and air-bells on the back are also removed.

Adjusting in position.

By the time this has been done the tissue will begin to straighten out, and just before the curl of the tissue begins to reverse, that is, before the paper backing becomes concave, showing that the gelatine has absorbed its fill of water, the tissue must be rapidly adjusted on the plate, and this being done, the plate and tissue together are removed from the dish, movement

of the tissue being prevented by pressure of the fingers.

Squeegeeing.

The plate is placed upon a flat level surface, and the squeegee applied to the paper backing. The fingers of the left hand are placed on the junction of the plate and the left-hand edge of the tissue to prevent movement, and with the right hand the squeegee is drawn over the paper backing of the tissue, beginning a little nearer the left hand than the middle, and drawing the squeegee, not too quickly or with too much pressure, from left to right, taking care that the pressure on the whole length of the squeegee is equal. The same procedure is gone through for the other half of the tissue, and then the superfluous moisture is removed with blotting-paper, and the plate set aside in a horizontal position for about ten minutes. This is in order to allow of the gelatine thoroughly attaching itself to the copper.

Developing bath.

While this is going on the developing bath should be prepared. It is desirable that the vessel should be large, and capable of holding a good depth of water. For plates up to whole-plate, $24 \times 18 \times 4\frac{1}{2}$ is a suitable size for the dish.

Development: Temperature.

The development of the resist does not differ in any way from the development of the transparency, except that after the paper backing has been stripped the temperature should not be raised above 100° F. if it can be avoided; though if it be found that the resist is over-exposed the temperature may be raised as high as 120°. I have previously explained why a medium temperature is desirable. Particular care should be taken that all the soluble gelatine is removed.

Drying off.

After the development is completed the plate is rinsed in cold water, and may then be set aside to dry in an upright position with its edge resting upon a piece of blotting paper. It is recommended that when possible the plate should be allowed to dry spontaneously in a place free from dust, but if for special reasons it is desired to proceed with the etching at once the resist may be quickly dried by taking a small quantity of methylated spirit in a measure, and adding to it an equal quantity of water, and flowing this over the plate in an even wave. As the spirit passes over the film it will be observed to take with it a slight scum, which is no doubt composed of

soluble gelatine. When the spirit reaches the end of the plate it should be allowed to flow off, and a further portion of the spirit is then flowed over the plate and allowed to drain off, whilst a small quantity of strong spirit is added to the mixture of spirit and water. The plate is then again flowed with the spirit, the mixture being strengthened at each application until the main portion of the moisture has been expelled; the plate may be placed in a dish and allowed to soak in spirit without added water for a few minutes, after which it may be taken out and allowed to stand until dry. The use of a whirler will materially assist the drying of the film, but if that is not at hand, it is desirable to fan the plate after treatment with the spirit in order to dry it as quickly as possible. The evaporation of the spirit so reduces the temperature of the plate that the moisture in the air has a tendency to condense upon it. The plate should stand for about half-an-hour after becoming apparently dry, in order to ensure that no moisture remains in the film.

Spontaneous drying.

If the plate is allowed to dry spontaneously, which will take some hours, it is desirable that this should take place in a cool room,

and that after becoming dry it should not be subjected to much variation in temperature. It has often occurred in the writer's experience that when the tissue has not been quite freshly sensitised, the film has stripped off the plate entirely on being brought into a warm room.

Varnishing margins.

The margins of the plate must now be protected with varnish, which may be composed of one part of bitumen dissolved in five parts of benzole. The varnish should be somewhat thin, as in that state it dries more quickly and thoroughly, and affords a better protection to the copper. The varnish is applied with a small camel-hair brush, but it will be found best, first of all, to draw a line all round, and just within the edge of the resist, with a draughtsman's ruling pen, charged with the varnish, using as a rule a steel straight-edge. The straight-edge should be supported above the copper-plate, in order to avoid damage to the resist (which is very susceptible to injury), or a piece of soft paper may be placed between the rule and the film. These lines having been drawn, it is quite easy to work up to them with the brush, and so secure straight and even margins to the picture. The back of the plate should also be varnished, and, when dry, the plate is ready for etching.

CHAPTER VIII.

THE MORDANT.

Perchloride of iron.

The most suitable mordant for etching the plate is neutral perchloride of iron. It is procurable as an article of commerce, as a solid body, yellow in colour, and very deliquescent. It is also sold in liquid form, but this is unsuitable for our purpose, being much more acid than the solid.

Solution.

To prepare the solutions, take seven pounds of the perchloride, and boil it in an enamelled iron pan with five pints of water. When the perchloride has completely dissolved, shown by the solution becoming transparent, take out a little in a test tube, and add to it a small quantity of freshly precipitated hydrate of iron. If the hydrate is not taken up by the perchloride of iron solution, it will be evident that the latter contains no free acid, and is in a suitable condition for our purpose. If, however, the hydrate is taken up by the perchloride, it will be necessary to add hydrate to the bulk of the solution until neutrality

Testing.

Neutralising.

is reached. Some idea of the quantity required can be formed by the amount used in the test; but the quantity added is not important, because any excess of hydrate beyond what is necessary to obtain neutrality will simply remain unchanged, and eventually settle to the bottom.

Hydrate of iron.

Fresh hydrate of iron is readily prepared by stirring liquid ammonia into a small quantity of the solution of perchloride of iron, when the hydrate will be precipitated. The hydrate is filtered out and washed until freed from ammonia, which may be ascertained by testing the droppings from the filter with red litmus paper, and is then ready for addition to the solution of perchloride of iron.

After boiling with the hydrate the perchloride is allowed to stand for some hours, and the clear portion can then be poured off, and the remainder filtered and added to it. It is not absolutely necessary to filter the whole of the solution, but I think it is worth while to take the trouble of doing so.

Testing strength of solutions.

The strength of the solution should now be tested by pouring a quantity into a tall glass jar, using a Beaumé's hydrometer for heavy liquids. At 70° F. the solution will

probably show a strength of 43°; if so, a twenty-ounce bottle may be nearly filled with it and duly labelled "43°," and the remainder may be boiled until at the same temperature of 70° F. the strength is raised to 45°, when a further quantity is taken out and stored in another bottle. Water is then added until 40° Beaumé is indicated, when a further quantity is bottled off, and so on, until further solutions of 38°, 36°, and 33° Beaumé are obtained, the complete range being six solutions of 45°, 43°, 40°, 38°, 36°, and 33° respectively, as indicated by Beaumé's hydrometer at a temperature of 70° F.

Range of solutions.

The water used in reducing the strength of the perchloride solution should be warm in order that the complete solution of the perchloride may not be disturbed.

The above quantity of perchloride (7lbs.) will yield about seventeen ounces fluid each of the range of six solutions.

These solutions improve with use, and it is as well before etching the first plate to put a strip of copper into each bottle for about a quarter of an hour, to take the first edge off the mordant.

Action of the mordant.

The solutions are given in the order in

which they are to be applied to the plate, and it will be observed that the first is the strongest.

A peculiar feature of the process is that a strong solution of perchloride has less corrosive action on copper covered with a resist than has a weaker one, because it has less penetrative power on the gelatine film. A saturated solution will not penetrate even the thinnest gelatine film. This is no doubt due, in great measure, to the viscosity of the mordant, and probably to some slight extent to the tanning action which it has upon the gelatine. The result of this peculiarity is that the 45° solution will only penetrate the thinnest portion of the resist, and when it encounters a thicker portion its action stops, and to continue the etching it is necessary to transfer the plate to a weaker solution. In this solution, 43°, the etching proceeds with the portions of the film next in thickness until it in turn encounters gelatine of a thickness which will not allow of its penetrating. The plate must then again be transferred to a weaker solution, and so on until the whole of the image is etched.

A strong solution of perchloride of iron is somewhat slow in filtering, without the use

of special appliances. A simple, yet efficient, apparatus is, however, easily arranged and fitted up. The materials required are a cheap form of Springel's pump made of glass, a wide-mouthed bottle, and some small sized rubber tubing. The bottle must be

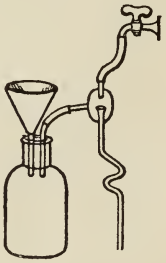


Fig. 6.

fitted with a good cork, which is perforated in two places to take the neck of the funnel and a short length of glass tubing, as in the accompanying sketch (fig. 6). The side and top tubes of the pump are connected respectively with the bent glass tube and a water tap by means of rubber tubing.

The action of the apparatus, when the tap is turned on, is to extract air from the bottle by means of the partial vacuum created in the bulb of the pump. And the liquid in

the funnel is caused to pass more quickly through the filtering medium and into the bottle in order to supply the place of the air withdrawn.

There are other mordants which it is possible to use in place of the perchloride of iron, but they have almost universally given place to the latter, and as it is my desire to indicate the most reliable methods of working, rather than to confuse the reader with alternative formulæ which offer no advantages, I have confined myself to the mordant described in this chapter.

CHAPTER IX.

ETCHING THE IMAGE.

Temperature of mordant.

Before beginning the etching the different solutions should be raised to an even temperature of 70° F. It is convenient to set the solutions out in order in dishes either of porcelain or celluloid of a size suitable to the plate to be etched. Two dishes only, however, may be used, if preferred, for the whole of the solutions, the next bath being prepared while the plate is etching in the previous one, but it is better to devote one's whole attention to the progress of the etching; and there is the objection that the strength of the various solutions is altered to some slight extent by the small quantity of the preceding solution left in the dish, though, perhaps, the alteration is not sufficiently great to be of importance.

The etching of the plate is a portion of the process about which it is difficult to lay down fixed rules. The conditions under which the etching takes place are rarely on different occasions identical,

even in resists printed from the same negative. A very slight variation in the thickness of the resist will require the etching to be proceeded with in a different manner, and, again, the humidity of the atmosphere has a considerable effect on the resist, dampness causing the film to allow the mordant to pass through it much more readily than when the film is absolutely dry. It must, therefore, of necessity be a matter for experience to teach how the etching is progressing, and what strength of mordant to use.

Guides to etching

Bearing in mind what has been said as to the principle upon which the etching proceeds, the best guide to the etcher is the appearance of the plate and the stoppage of the etching. Theoretically, the strongest solution, 45°, should commence to etch the shadows within a minute after the plate is immersed in it, and the plate should be continued in this solution until the etching appears to stop. There may perhaps be three tones in that portion of the film which this first solution will attack. The action shown by discolouration of the copper will first be seen in the thinnest part, and shortly afterwards the next tone will begin to darken, and finally

the action will spread to the third tone, and beyond this it will not go, and it is this ceasing to spread which is meant by the expression "stoppage of the etching." As a matter of fact, the etching does not stop, because in those parts where etching has begun it still continues, but nowhere else. When this stoppage occurs, it indicates that the plate should be transferred to the next weaker solution, which will take up the etching where the preceding solution left off, and if this is not done the etching will, of course, go on where it is already at work, and when the plate is eventually transferred to the weaker solution, there will be a distinct step in the gradation between the tones etched respectively by the two solutions. To give an idea merely of the time which may be occupied in the different etching-baths, the following table is given showing the time for which the plate forming the frontispiece was etched :

Frontispiece: Table of etchings.

Solution.	*Time of Etching.*	*Solution.*	*Time of Etching.*
Beaumé 45°	No effect.	38°	4 mins.
,, 43°	2 mins.	36°	3 ,,
,, 40°	4 ,,	33°	2 ,,
			Total time, 15 mins.

Solution 45° began to act two minutes after immersion of the plate.

This table must not be taken as an

infallible guide in etching other plates, because it is impossible to accurately describe the conditions as to state of atmosphere, thickness of resist, etc., under which the etching took place, but for a trial plate this example may well be followed.

Number of baths.

Usually, five etching baths will be found sufficient to complete the etching of a plate. If the resist be a thin one the 45° bath will etch the deep shadows, and 36° will be sufficiently weak to penetrate the highest lights if the contrast be normal.

Thick resist.

If, on the other hand, the resist be somewhat over-printed, 45° will not penetrate at all, and the 33° bath will probably be found necessary to complete the etching.

Management of etching.

It is not desirable that the 45° bath, or the 43° if that be the first solution to attack the copper, should be allowed to act for too long a time. Its action is very slow in spreading to thicker portions of the resist, and as the effect of each succeeding bath is cumulative, the portions of the plate affected by 45° may, if it be allowed to work too long, be over-etched by the time the lighter portions are etched sufficiently deep.

Effect of over-etching.

It will be remembered that the capacity of the plate to yield dark tones depends not only on the depth of the etching, but on the presence in the shadows of the unetched points protected by the ground. By over-etching, these points are gradually undermined until they do not suffice to imprison the ink, and the depth of the tone is reduced instead of being strengthened as might be expected.

It may be taken as a general rule that the first etching bath which attacks the copper—whether it be 45° or a weaker one—should not be allowed to act longer than two minutes before the plate is transferred to the next weaker bath. The second bath, for similar reasons, should be stopped rather before than after it has ceased to attack fresh portions of the plate; while the third and fourth baths, which do the greater portion of the work, should be used well up to their limit, and the last one until the etching is completed.

Control in etching.

There is considerable control over result in the way in which the plate is treated in the etching: If it is desired in the reproduction to reduce the contrast present in the original negatives, solution 45° may be

omitted altogether, as that would act only upon the shadows, and so increase their depth. Solution 43° may be allowed to act for one minute only, the remaining solutions being used as usual.

A subject lacking in contrast may be improved at slight expense as to the original scale of gradation by working solution 45° right up to its limit, and following with special solutions, made up by mixtures of the standard solutions, of more widely differing strengths, *e.g.*, beginning with 45°, and continuing successively with 41°, 38°, 34°, 30°, and 28°, if necessary.

Etching delicate subjects.

In the case of some subjects with a very delicate scale of gradation, the ordinary method of etching may be abandoned with advantage, and the etching be begun with a small quantity of the strongest solution that will touch the copper. This solution is diluted from time to time with a few drops of water, until the whole of the image is etched. The water must be added in very small quantities frequently, and in the same way in which one would an accelerator in developing a photographic negative, *i.e.*, first pouring the water into a measure, adding the etching solution, mixing together,

and returning to the dish. Care should be taken that the added water is not of a lower temperature than the solution, otherwise the perchloride may be precipitated.

By this method nothing of the gradation is lost if the etching is properly managed, but it requires some experience to carry on the etching at the proper speed by diluting the solution so that the high lights are attacked neither sooner nor later than the moment when the shadows have attained their proper strength.

When using the red autogravure tissue there is no difficulty in observing the progress of the etching, as discolouration of the copper takes place wherever the mordant attacks it, and the transparency of the resist readily permits of this being observed.

It may not be necessary to employ the whole range of solutions to complete the etching of the plate; when the discolouration of the copper has extended to the whole of the image, it is unnecessary to use a weaker solution, but the action of the mordant should be allowed to proceed in the solution then in use for about half a minute after the whole of the detail has been

obliterated, in order to get proper printing strength in the higher tones. For instance, in a subject showing clouds, the whole of the sky should be allowed to blacken before the plate is removed from the mordant.

Removing resist.

When etching is completed, the plate is quickly removed from the mordant, and held under a strong stream of water, whilst the film is removed by gentle rubbing with the fingers. If the tap is not conveniently near, a small quantity of American potash or other strong alkali may be poured on the plate, and rubbed over it with a pad of cotton-wool. This, by neutralising the mordant, will prevent further action, and the film can then be removed with less haste by friction in water.

Appearance of plate after etching.

The plate is dried, and may now be examined. The bitumen grain should still be present all over the plate. The only place where it is likely to have given way, owing to the lateral as well as vertical action of the mordant, will be in the shadows, and if it has given way here to only a slight extent, the printing qualities of the plate will not be seriously interfered with.

The appearance of the plate at this stage will be very disappointing, and to the novice

may seem to indicate failure, which impression may, however, be far from correct.

Removing grain: cleaning plate.

The grain is removed along with the varnish on the margins and back with a pad of cotton-wool moistened with benzole, and, when this has been done, the plate may be flowed with American potash, and vigorously rubbed with another pad of cotton-wool. After rinsing, this should be followed with weak sulphuric acid, about one part to twenty, which will remove the blackness from the etched portions. If the plate is not now thoroughly clean, weak nitric acid should be applied in the same way, and it may finally be polished with the oil rubber.

After this, the plate will present a much more satisfactory appearance, and, on examination with a magnifying glass, it will be seen that the etching corresponds in depth to the tones of the picture, and throughout the subject, from the shadows to the high lights, will be seen the small specks of bright copper, portions of the original surface, which have been protected by the grains of bitumen, and which will serve to imprison the ink in the depressions caused by the etching.

GRANADA

CHAPTER X.

PHOTOGRAVURE IN LINE.

The procedure in the case of a line subject may be identical with the foregoing, except as to the etching, but special attention should be given to the preparation of the negative. The production of a perfect line negative on a gelatino-bromide plate is an art in itself; the principal points to observe are the proper lighting of the drawing or engraving, the use of slow plates with accurate exposure and careful development with a weak and well-restrained developer. The lines of the subject must be represented by perfectly clear glass on a black ground, otherwise success in the after processes will not be attained. With whatever care the gelatine negative may be prepared it will scarcely equal a negative produced by the wet-plate process, and if the latter can be obtained, by all means use it. I have, however, prepared satisfactory negatives on various slow plates, amongst which the slow isochromatics can well hold their own.

Line negatives.

The ferrous-oxalate developer can be recommended as giving good results with correct exposure. Or a hydroquinone developer of about half the usual strength, with twice the normal quantity of citric acid, will be found reliable, and perhaps more convenient, by the general worker.

The negative will require to be intensified, which may be done by any of the mercuric methods, and particular care should be taken in thoroughly fixing the negative, clearing away all fog, and washing thoroughly both after fixing and between the two operations of bleaching and blackening the image.

The best method of producing the line transparency is by contact on a slow gelatino-bromide plate, and the same developer may be used as is recommended for the negative. If this method is adopted, however, a reversed negative will be required. Reversal of the transparency in the camera is not available, because of the tendency to a widening of the lines by halation from the clear glass of the negative.

The carbon process, however, is fairly satisfactory for line subjects if the negative be a strong one, care being taken in the exposure of the tissue, so that the greatest

possible strength of line may be obtained, consistent with a ground of clear glass, in order that a thick film of gelatine may be obtained in the resist in the parts representing white paper.

If there is little contrast between the lines and the ground, the mordant may etch through in places where the copper should remain untouched. A line transparency is readily intensified with a solution of permanganate of potash. I have found it a good plan in the case of line subjects to develop the transparency on finely-ground glass; the roughened surface readily retains the pigment in position without the use of a substratum, and the subsequent intensification with permanganate of potash is more effective because of the absence of the stain which spreads over the white ground of the subject when a gelatine substratum is used, and to some extent neutralises the effect of the intensification. And if the transparency is, when dry, collodionised or varnished, the granular appearance of the glass is obliterated.

Intensification.

When developing the transparency, if a slight veil should extend over the whites, a wisp of cotton-wool may be trailed over

it while it remains in the hot water, but no pressure must be employed, otherwise the lines will be displaced. After development, the transparency should be hardened with alum, and, when dry, protected with a film of plain collodion or varnish.

The ground.

If the subject is in pure line, *i.e.*, without blotches of ink undivided into line, the copper plate should, theoretically, only require to be grained for the purpose of affording a surface for the resist to adhere to; the separation of the lines by spaces of unetched copper might be expected of itself, as in etchings, to afford sufficient inkholding power to enable printing to be carried out. The lines in a photogravure plate, however, differ very considerably from the lines in an etching. The former are shallow and broad in comparison with the etched line, and in order to obtain the full value of a broad line, or the crossing of one line over another, the ground is essential. The ground for a line subject should be fine in character, and not so abundant as for a half-tone plate unless the lines are not clearly separated, in which case the plate will require to be grained, on the same principle as in the

case of a half-tone subject, *i.e.*, if the subject is strong and dark, a coarser and more abundant grain will be necessary than if the subject were light and delicate.

Etching.

The development and mounting of the resist on the copper present no variations in procedure. In etching the plate, as there is only one tone to produce, and that tone is represented by what should be practically bare copper, one etching bath, or at most two, will be required. The solution 40° Beaumé is generally most suitable, and at a temperature of 70° F. etching should commence all over the subject about the same time, and be complete, if black lines are desired, in eight to ten minutes. If, owing to a slight film of gelatine over the lines, the etching should not commence shortly after immersion of the plate in the mordant, and so should not attack the plate evenly all over the subject, a weaker mordant should be used; but the fault of unevenness can only occur through faulty manipulation in development of the resist, in cleaning the copper-plate, or through defects in the negative or transparency.

CHAPTER XI.

PRINTING FROM THE PLATE.

The plate having been cleaned after etching, a proof should be taken from it or "pulled," as it is called, technically. Up to this point the expense incurred to enable one equipped for ordinary photography to work the process of photogravure, has been small—some £3 only—and many who do not intend to embark commercially in process work will, no doubt, hesitate to incur the expense of setting up a small printing establishment in their homes. But I can assure them from personal experience that a great amount of pleasure may be derived from the possession of a copper plate printing press, and I have no hesitation in saying that the interest attaching to the production of one's own prints is well worth the outlay.

The actual printing of the plate presents no difficulties beyond such as must necessarily be present in any work that is undertaken by a person of intelligence, if it is to afford him pleasure.

Advantages of proving own plates.

Beyond the fact that the work is pleasant, there is a great advantage in having the means and the ability to prove one's own plates; one gets a better grasp of the whole subject of photogravure, and understands what qualities in the print must be derived entirely from the plate, and what the printer's art may be relied on to confer.

There is considerable art in the printing of an intaglio plate, and its full extent can scarcely be realised without personal experience. Two printers of equal ability, if they were asked to print the same plate independently of each other would produce widely differing results, especially if the plate were an etching, although the work of each man might be excellent. This is due to the fact that there is a wide field for the expression of the printer's individuality, and their interpretation of the subject may differ, while each interpretation may be truthful.

The variation in results to be obtained from a photogravure plate is considerably less than in the case of a line subject, whether the subject be a photograph from nature or a reproduction of a picture, because the intention of the author or artist is now fully expressed on the plate, and

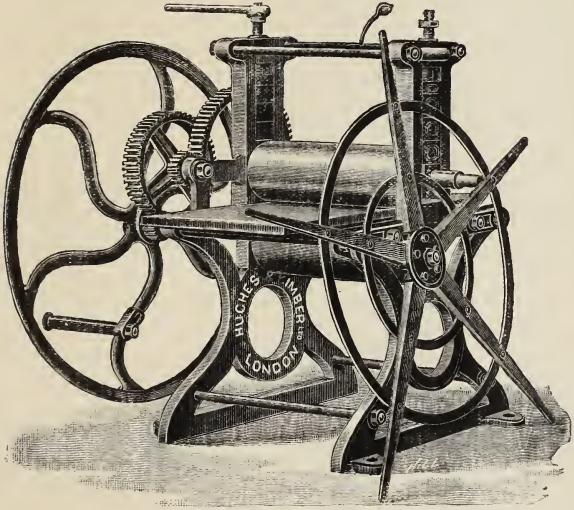
less is left to be expressed in the printing of it. Still to a certain extent the power of expression remains, and, even if the printing is not to be done by himself, it is desirable that the *photograveur* should pull a proof as a pattern for the printer, and, for the same reason that an etcher often proves his own plates—that he may finish what he has begun by impressing upon the print the intention present in his mind when he produced the original.

Plate printers.

Having said so much as to the desirability of pulling one's own proofs, let me add that the courtesy generally met with at the hands of plate printers prevents the desirability becoming a necessity. They will usually, at any rate by appointment, arrange to prove the plate in one's own presence, and the writer has found them most painstaking in carrying out suggestions, pulling proof after proof until one satisfactory in all respects is obtained.

I propose now to describe, as well as in words I am able, the method of pulling a proof, but no amount of writing will produce a skilful plate printer, and I can only hope to save the beginner some trouble by indicating the way in which he should go about

the work. First as to appliances and materials:



THE PRINTING PRESS.

The rollers are of iron; the top one is revolved by means of the "cross," as the handle is called. The press shown in the cut is of a larger size than is necessary for an amateur printer, and is furnished with geared wheels, a great advantage when large plates are being printed. The bed plate is of iron, its surfaces are planed up true, and the

motion given to the top roller causes the plate to travel by means of friction, obtained by pressure applied by screws to the top roller, and in travelling, motion is communicated to the lower roller upon which the bed plate rests. The rollers and bed plate are not geared together in any way. The pressure may be varied by means of the screws, and the packing between the pressure screws and the bush in which the axle of the top roller revolves should be partly of wood or millboard, in order to allow of a certain amount of spring in the pressure. To complete the equipment of the press "blankets" are required, somewhat larger than the largest size of paper intended to be printed on. These consist of two kinds, which are specially made for the purpose—"fronts," or the kind which is to come next to the paper, are, of very closely woven woollen material resembling "melton" cloth of great substance; and "middles," a coarser and more open material. Two fronts will be required next the paper with one, two, or three middles on the top of them, according to the character of the plate being printed. It is convenient to attach a string to the blankets, pass it over the pulley, and hang to it a weight sufficient to lift the

blankets clear of the paper as the latter, with the plate beneath, emerges from between the rollers.

Plate Papers.

The paper suitable for plate printing is of a special kind, almost, if not quite, free from size. It should absorb water readily, and it is prepared for use by dipping each sheet, cut to the desired size, separately in clean cold water, and stacking the sheets one on top of the other in a pile with a plate of glass on the top, and leaving them under a weight for some hours, in order that they may get thoroughly damp. The length of time paper will require to stand before attaining the right condition will depend on the amount of size it contains, the effect of the size being to render the paper less absorptive. If time is of importance the paper may be brought into condition more quickly by using hot instead of cold water to dip the sheets in.

For trial proofs a Dutch plate paper, either "laid" or "wove," is recommended. It is cheap, and quite good enough for that purpose, or for practising on. For higher class prints there are several kinds of Japanese paper of excellent quality and colour which yield prints of a character well suited to some subjects. The plates in this book are printed on a Japanese paper.

There is no difficulty in obtaining a range of other plate papers from the merchants, differing so widely in character that all tastes and subjects may be suited.

Copper-plate inks.

Copper-plate inks are quite distinct from ordinary printer's inks, and these latter are quite useless for our purpose.

The ink can be purchased ready ground with oil in a very stiff paste, and it only requires letting down slightly with oil to make it ready for use. Plate printers prepare their ink freshly day by day, and say that it deteriorates very fast, losing its brilliancy and richness, even when kept from the air. This may be so, but it is convenient to keep a little ink always handy, so that a single proof may be pulled at any time without the troublesome preliminary of grinding fresh ink. The best way of keeping it is in a collapsible tube, such as oil colours are sold in, only larger. A half-pound tube will last a very long time if it is used only for trial proofs. If an edition is to be printed, it is better to grind fresh ink, because the colour may be varied until one exactly suiting the subject is obtained. The principal pigments used in the preparation of the ink are Frankfort black or drop black; umber, raw

Materials for inks.

and burnt; sienna, raw and burnt; and vandyke brown.

The black is the chief ingredient, the other pigments being used to vary its shade; Frankfort black with a little carmine added gives a very rich black. A warm black or rich brown may be obtained by varying the proportions of black and burnt umber.

A slab of marble or an old lithographic stone will be required to grind the ink upon, and a piece of marble, similar in shape to an inverted cup, but solid, and called a "muller," to grind it with.

The pigments are obtainable in powder form from any printer's furnisher, and he will probably be able to supply the burnt linseed oil used for grinding them in. Two strengths of oil, thin and medium, should be obtained, so that the character of the ink may be varied.

Grinding the ink.

To prepare the ink, take some of the dry colour, and with a palette-knife mix it on the ink slab with a little of the thin oil, then take the muller, and, by vigorous grinding, mix the colour with the oil, from time to time adding more colour or more oil as may be required, until on taking a quantity of the ink on the palette-knife it can only be pre-

vented from dropping off by keeping turning the knife. This is the best guide I can give as to consistency. If a stronger ink is required, that is, one which gives a darker print, especially in the deeper tones, the medium oil may be used, as it is of a more clinging nature, and adheres more strongly to the plate during wiping. The grinding must be continued until all grittiness is removed and the pigment is thoroughly incorporated with the oil, otherwise it will not stand.

Plate-heater.

The heater is a plate of iron standing on four legs, and beneath is a perforated gas-pipe in the form of a ring. A heater may be improvised with an ordinary circular gas stove and a piece of stout sheet iron. A photogravure plate requires very little heating, and the heater may be entirely dispensed with without much inconvenience, as the plate can be warmed over the gas.

Wiping muslins.

The cloths for wiping the plate after inking are of muslin of different degrees of coarseness; old and well washed plain muslin curtains answer very well for the finer cloths. The coarse muslin used first to remove the bulk of the ink from the surface is very open in texture and somewhat stiff;

the proper material should be obtained from a printer's furnisher.

The wiping muslins should be kept together away from dust and dirt; they are generally kept in the "jigger," a box of a suitable size having a polished mahogany lid upon which the plate is inked and wiped. Of course, the lid need not be mahogany, but it should be of smooth hard wood, to which dust, which might scratch the plate, will not readily adhere. A box about ten inches high will, when placed upon an ordinary bench or table, bring the plate to a convenient height for the inking and wiping operations.

Inking dabber.

The inking dabber is a roll of woollen cloth or flannel used for applying the ink to the plate. A dabber may be purchased from the printer's furnisher for a small sum, but if it is preferred to make it, take a long strip of woollen material, not too closely woven, about five inches wide, and out of one side of it cut narrow V-shaped pieces about three inches long at varying intervals now roll the flannel up tightly until the base is about four inches in diameter, and stitch the end fast. Some cord may be wound round the neck of the dabber, which will be smaller than

the base, and of a convenient shape for holding in the hand. If the surface at the base is uneven, take a slice off it with a sharp knife and then cover it with a piece of the "front" blanket, which can be stitched fast to the cone of the dabber. This outer covering can readily be replaced when it gets stiff with old ink dried on. If the dabber were not covered, a slice would have to be cut off it whenever it got hard with the old ink remaining on it, and so it would gradually be destroyed.

The printer's requisites being at hand, we will proceed to pull a proof from the plate which has already been cleaned after etching in the manner described.

If the dabber is a new one, the ink must be worked into it by rocking it about in the ink on the slab until it is well charged, otherwise it will not communicate sufficient ink to the plate.

Inking the plate.

Now warm the plate on the heater until it is nearly as warm as the hand can bear, and remove it to the jigger for inking. Take a little ink up on the dabber, and, holding the plate by one corner, work the ink into the depressions by a rocking motion of the dabber, making the latter at the same time

travel gently forward. The object is to force the ink into the depressions, and avoid lifting it out again with the dabber, and the forward rocking motion is best calculated to effect this. The plate must not be "dabbed," that is, pressed on the plate and lifted straight up again, as the name "dabber" might lead one to infer; the ink would by so doing be lifted, partially at any rate, out of the depressions, instead of being left there.

In inking a plate for the first time the dabber should be worked freely in all directions, in order to insure that the plate has taken the ink thoroughly. Afterwards a certain amount of ink will remain in the plate after it has passed through the press—as can be proved by passing it through a second time with a clean piece of paper—and going over the plate once will be found sufficient to ink it thoroughly.

It will be understood that in the process of inking the whole surface of the plate will be blackened, and it is now necessary to remove the surface ink while leaving that in the etched portions. To do this, take a piece of coarse muslin, say two feet square, and gather it together loosely, turning the

Wiping the plate.

edges inwards so that they form a soft packing for the centre, which should be free from creases. The mode of folding is the same as that employed when preparing a duster for use; its size and shape when folded should be that of the hand that is to use it, when open. Take this folded muslin in the extended right hand with the smooth centre outwards, and with a circular motion of the hand wipe the plate towards you, turning the plate round from time to time until the greater portion of the ink has been removed from the surface. Holding the plate in the hand, run a rag round the margins to remove the bulk of the ink, so that it is not again drawn on to the picture when continuing the wiping; then take a piece of the finer rag folded in the same way, and repeat the process of wiping. It will be found that to take up the ink evenly, the rag must be slightly charged with ink to begin with, and it will continue to wipe satisfactorily long after it has become quite black with the ink taken up.

The plate will have cooled considerably during the process of inking, and usually it should not be more than lukewarm when the wiping is done. The ink becomes more

adhesive on cooling, and is better retained in the depressions, while the surface ink is softened by warming the rag on the heater occasionally during wiping.

Points to observe

The principal points in the wiping are to keep the rag moving—never letting it stop while on the plate; not to use too much pressure with a view to removing the ink quickly, but to work gently and regularly over the plate until only a slight film of ink remains.

The wiping is finished with the ball of the hand, working it lightly, but smartly, over the plate with the same circular motion, and turning the plate round from time to time until the surface appears bright and free from streaks. I say *appears* bright, because there will really still be a tint left over the whole plate. If this is not desired, the ball of the hand should be passed over a lump of washed whiting, and, after lightly wiping off the surplus whiting on the apron—which should always be worn—the wiping is continued until the surface of the plate is polished quite clean, in which state it will yield what is called a " natural " print.

Cleaning margins.

The margins are now cleaned with a piece of slightly damped washleather, which

should be attached to the apron, and whiting. A fold of the washleather is thrown over the thumb, a little whiting taken up on it, and, using the first finger as a guide to run along the edge of the plate, it is applied briskly to the margin, taking care not to encroach on the subject. The plate during this operation should occupy a position on the lower right-hand corner of the jigger, and the right hand margin is then cleaned, drawing the thumb from top to bottom towards the operator, the plate being prevented from slipping off by the thumb of the left hand applied to the bottom edge. The plate is turned round from time to time from left to right, so that the margin being cleaned is always the right-hand one, and, finally, the plate is supported in the hand, while any marks made by the left-hand thumb are carefully removed.

The plate is now ready for the press. It is well to have a thin sheet of zinc somewhat larger than the paper upon which the print is to be made to put the plate on when passing through the press, because the photogravure plate being smaller than the paper, it is necessary to have some guide

to ensure the print being in the middle of the paper. A piece of clean paper will do equally well, but it requires frequent renewal, while the zinc plate is easily cleaned and always ready.

Pulling the proof.

Place the plate face upwards in the middle of the zinc plate or paper guide on the iron bed of the press—there must be no soft material between the plate and the bed of the press, or the plate will be bent—take up a piece of the damp printing paper, remove any surface moisture with a sheet of clean tissue paper, and brush it over lightly with a soft flat brush, to remove loose hairs, etc., and lay the paper face downwards on the plate, using the edges of the zinc plate as a guide. Lay three or four thicknesses of blanket on the top of the paper, the fine fronts next the paper, and revolve the cross so that the whole pass under the roller. When the plate emerges on the other side raise the blanket and carefully remove the paper; if it sticks very closely, the plate may be slightly warmed.

Variations in printing.

The first proof from a plate is often unsatisfactory, and a second should be taken before judgment is passed upon it. The

first is often mealy and granular in the shadows, owing to the plate having taken the ink imperfectly. If the second proof is weak in the shadows, the pressure on the rollers should be increased, or another thickness of blanket may be added, and if the print is still unsatisfactory in this respect a stiffer ink must be used, and the plate be allowed to become quite cold before wiping.

A different result may be obtained by varying the foregoing manipulations. If the plate is too strong generally, and yields too dark a print, the ink may be thinned down with oil; or a weaker colour may be used in preparing the ink—some colours are much stronger than others, although the ink be of the same consistency—or the plate may be kept warm during wiping. And the converse holds good in the case of a weak plate.

In the case of a plate too strong in parts only, the particular parts may be wiped with a softer rag, with more pressure and wiping more slowly—if the rag is *dragged* over the plate, more ink will be removed than by a quicker motion.

Having pulled a few proofs and humoured

the plate as each succeeding print appears to require, you will then be able to determine in what respects the plate is defective; and if the defects are capable of being remedied, you may work upon it in many ways on the lines laid down in the succeeding chapter. Proofs should, however, be frequently pulled, in order to see that the work is having the desired effect.

CHAPTER XII.

AFTERWORK ON THE PLATE.

One of the chief difficulties in retouching the plates is to make the afterwork harmonise with the original. In many published photogravures, this point has not been sufficiently regarded, and otherwise fine pictures have been spoilt by injudicious handwork. It is far better to discard a faulty transparency or resist than to trust to retouching on the plate to cover up faults resulting from careless work; and if the negative is not perfect and another cannot be obtained, the work should be done with brush and pencil on that and on the transparency in preference to working on the plate itself. The process is quite capable of yielding a sufficient scale of gradation, without after manipulation in strengthening shadows and burnishing high lights if full advantage be taken of its resources.

If a photogravure plate be carefully examined, it will be seen that the image, split up as it is by some thousands of hillocks to the square inch, and each valley

differing in depth from its neighbour, could not possibly be *imitated* by toolwork, and if tools are employed, the best that can be done is to assimilate their work to the original general character as nearly as possible. Having said these few words by way of preliminary, I propose to describe various means by which a plate may be retouched. Which method should be used in the case of any particular plate can only be decided after seeing the plate itself.

Re-etching.

A plate may be strengthened as a whole, or in any particular portion, by re-immersing it in the mordant after having again covered over with a protecting medium the tiny specks of the surface, which were originally protected by the bitumen grain. This is accomplished by rolling the plate up with a greasy ink applied with a leather or hardened gelatine roller. The ink is composed of the following ingredients:

Asphaltum	....	....	1¼ ounces.
White wax	....	....	3 ,,
Stearine	....	....	3¼ ,,
Spermaceti	...	....	7 ,,

First melt the asphaltum in a water-bath, and gradually add the other ingredients,

stirring the while, until thoroughly incorporated. The ink may be run into cakes for purposes of storage. I believe this or a similar ink is sold under the name of "finishing ink."

The roller should be purchased from a dealer in process materials. Its surface must be perfectly even and true, and it would prove a delicate task for one to attempt to make it for himself. I think the leather-covered rollers are to be recommended, but gelatine rollers, the surface of which has been hardened by treatment with bichromate of potash and exposure to light, are cheaper, and can be used for the purpose. When not in use, the roller should be hung up, and not left resting on its surface, or a flat place will be the result, and, if of leather, should be greased with tallow to keep it in condition.

To ink or "roll up" the plate, dilute a little of the ink with turpentine, working it up with a palette knife on a sheet of plate glass, or a lithographic stone. Now pass the roller over the stone several times, and in different directions, until evenly charged with the ink. There will, however, be so much ink on the roller at this stage that, if applied to

the plate, the depressions, as well as the surface, would be covered. To remove the surplus, clean up the ink on the stone, or, better still, take a second stone, and pass the roller several times over this until the roller has on it only the thinnest film of ink. If the ink is of the right consistency, it should be quite tacky at this stage, and the passage of the roller over the stone should be quite audible. If the ink is too thin, a little time should be allowed until the turpentine evaporates.

When the roller is properly charged with ink, place the plate, which must be thoroughly cleaned, as when originally preparing it for etching, on the jigger or bench, and pass the roller over its surface backwards and forwards, with very slight pressure, and turn the plate round from time to time, so that the roller passes over it in all directions.

The extent to which the rolling up is to be carried depends upon the portion of the plate it is desired to strengthen. If the rolling is continued long enough, more ink being taken up as required, the whole of the image will be obliterated; or the rolling up may be stopped a little short of this, so that only the deepest shadows are

uncovered, and so on. If it is wished to strengthen the whole plate, it must be rolled up only until the bright specks of the original surface have been covered; further inking will gradually obliterate the image beginning with the parts least deeply etched, and continuing from tone to tone until the ink extends to the deepest shadows.

After rolling up, the plate is thickly dusted with finely powdered bitumen, and the powder not taken up by the ink is lightly brushed off with a soft brush; the plate is heated until the bitumen becomes incorporated with the ink, and the image becomes distinctly visible. If the rolling up has been properly done, a marked change will take place in the appearance of the plate at this stage, which cannot be mistaken. The image, which up to now has been almost obliterated, will start out quite brilliantly.

When cool, the plate is ready for etching after having its back and edges protected with varnish. Any portions of the image may be stopped out with varnish, and the etching proceeds for such time as the plate may require in the perchloride of iron bath at 40° Beaumé.

Where it can be employed, the re-etching

method is undoubtedly the best method of retouching, as the character of its work is identical with that of the original etching.

In aquatinting, the plate is regrained in the dusting box, and the dust fixed by heat—exactly as in preparing the plate before etching; and, when the plate is cool, the parts desired to be strengthened are painted over with a small brush dipped in a weak solution of perchloride of iron. The strength of the solution depends upon how long it will take the operator to apply the mordant, and whether he desires to produce a flat or a graduated tint. Generally it will be found convenient to dilute a small quantity of the solution 33° Beaumé with an equal bulk of water, and with it to work on a small portion of the plate at a time, frequently rinsing the mordant off under a strong stream of water, drying with a clean linen rag, and applying the mordant again if required. If the subject is a very delicate one, and there is a good deal of work to do, it will be desirable to stop out the lighter portions with black varnish, to prevent their being degraded by the mordant spreading over them in rinsing it off. Aquatint.

The brush used should be mounted in

quill, not metal, but the mordant will be found to affect the hair in course of time. Weak nitric acid, 1—20, or the Dutch or other mordant, may be used if preferred, but they will be found more destructive to brushes than the perchloride of iron.

Aquatinting, as above described, harmonises perfectly with the original biting, the principles being the same in each case, and it should be used in preference to tools in all possible cases. There is, however, a certain loss of detail, as the mordant acts to an equal extent on the whole of the surface unprotected by the grain, not being restrained, as in the original etching, by the varying thickness of the resist film.

Roulettes.

A roulette consists of a handle resembling a penholder, with a small steel wheel fixed in one end in such a way as to permit of the wheel revolving when it is drawn over the copper. The wheel has a serrated edge, and its sharp points indent the copper to a greater or less extent, according to the pressure employed in using the tool. Roulettes vary considerably in the width of wheel, from a single line of points to about half a dozen ; in the broader kinds the surface is similar to that of a fine file.

With the single-lined roulette the finer passages are put in, and lines drawn, while the broader tools may be employed for strengthening broad shadows or other work where the area to be worked upon is comparatively large. The wheel should be kept well oiled, so that it may revolve readily, otherwise scratches may be made instead of indentations.

In using the roulette, it should be remembered that the actual printing value of its work is increased by the fact that a slight burr is raised round each indentation. It is often desirable to remove this burr with charcoal. The work of the roulette is well suited to photogravure plates, and is seldom obtrusively apparent unless used to a great extent, or in the lighter tones of the subject.

Etching point.

There *are* occasions when the etching point may be used with advantage in conjunction with photogravure, but they are few; and it requires great judgment to know when and how to employ it. There is nothing in common between the line of the etching point and the pure half-tone of photogravure. I have a little mezzotint of Semour Hayden's that, I think, strikingly

demonstrates this clashing of line and half-tone. The little plate is a gem in every way, except for the etched lines, which, for me, quite take away the charm of the subject. Still, the operator may on occasion desire to use it in some dark corner of a plate where strength is required, and the lines may not be obtrusive. It will be necessary first to prepare the plate by covering it with an etching ground; wrap up a small ball of etching ground in a piece of fine taffeta silk — the ground is composed of asphaltum, wax, and tallow, but it will save much trouble to purchase it ready prepared —heat the plate slightly, and rub it over with the silk-covered ball until a sufficient quantity of the ground has exuded through the silk on to the plate. To distribute the ground evenly, pat it gently with a silk-covered dabber while the plate is still warm. In this way it will be found quite easy to get an even thickness all over the plate. The dabber consists of a disc of cardboard some two inches in diameter, upon which is laid a little pile of curled horsehair, and upon the top of that a thin layer of cotton wool, and the whole is then covered with fine taffeta silk, which is tied at the back

of the disc, not so tightly as to lose the spring of the hair.

With the etching point the desired lines are drawn on the plate, taking care that the point penetrates through the ground right to the metal. The work should be done from left to right of the plate, so that the hand does not travel over lines already drawn, and, as the ground is delicate, a pad of soft paper should be interposed between the hand and the plate.

When the lines are all drawn, the margins and back of the plate are protected with varnish, and the plate immersed in perchloride of iron, or any other mordant, and left there, meanwhile removing with a feather any bubbles which may be formed, until the desired depth is obtained. The plate may be removed from time to time, rinsed and dried, and lines sufficiently bitten stopped out with varnish, and the etching be continued until complete.

The etching point may also be used as a "dry point" for drawing lines without the aid of etching ground and mordant. If the point is held in the hand in a sloping position, it will raise a burr in drawing the line, and the strength of the line will be

proportionately greater unless the burr is removed. The burr raised will be considerably less if the lines are drawn with the point held vertically.

Sandpaper.

Sandpaper can sometimes be usefully employed for strengthening a plate by pressing the rough surface into the metal. The coarseness of the sandpaper will naturally have a great effect on the result.

A plain tint may be given to a sky or stretch of water without detail by spreading flour of sulphur mixed with oil over the cleaned plate. The effect is not, however, very durable, and is lost after a few impressions have been taken.

There are various means also of reducing over-bitten passages.

Burnisher.

The burnisher is the chief of these, and it has been previously described. It is as well to have a variety of shapes to choose from, and great care should be taken to keep them free from rust. Before using a burnisher that has been laid by for any length of time, it should be cleaned and polished. This is readily done by cutting a V-shaped groove in the end of a board, sprinkling a little flour emery on it, and rubbing the burnisher up and down in it,

finishing off in a second groove, using whiting as the polishing medium.

In order to reduce a passage evenly, dip the burnisher in oil, or moisten it in the mouth, and rub it backwards and forwards with little more pressure than its own weight, each stroke just clearing the previous one, and, when the whole area has been covered, turn the plate round and repeat the process with the lines in a different direction, and continue turning the plate round and burnishing again until the reduction is sufficient. It is better to work in this tentative manner than to endeavour by each stroke to reduce the printing qualities of the plate to the point desired. This may, of course, be done where the part to be reduced is quite small, but for a large area, such a course would result in great unevenness.

Charcoal.

A stick of willow charcoal may also be used for reducing any large portion of a plate that has been over-bitten. The bark should be carefully removed, or it will scratch the plate, and one end should be ground flat, a piece of roughly ground glass is useful for this purpose. The charcoal is then soaked in water, which gives it

a stronger tooth, and the plate is gently and evenly rubbed down with it with a circular motion, using oil as a lubricant.

Charcoal is preferable to the burnisher in many cases, because the latter does not remove the copper, but merely crushes the little hillocks, more or less, into the depressions, thereby destroying detail to a certain extent. Charcoal, however, wears down the tops of the hillocks, and so reduces the ink-holding capacity of the plate without otherwise affecting it.

When using charcoal the plate should be frequently rinsed, to free it from the loose particles, which form a paste, and would otherwise wear down the bottom of the depressions.

The scraper.

The scraper is principally of use in photogravure for removing small defects in the etching, or the burr caused by the use of the dry point. As to the former, the method of using it has been described in Chapter V. The scraper consists of a triangular blade, having three cutting edges, set into a handle. To remove the burr from a dry point line, hold the blade of the scraper with one side flat to the plate, and make the cutting stroke in the opposite direction

to that in which the line was drawn. The cutting edge should be held obliquely to the line, so that the cut becomes a slice instead of a straight cut through. If the scraper is properly ground and sharp, there is no need to fear injury to the plate, as only the portion standing above the surface will be removed.

CHAPTER XIII.

STEEL-FACING THE PLATE.

A photogravure plate should yield fifty prints without much sign of deterioration. Some plates may stand more work than this, and others not so much, according to the depth to which the etching has been carried and the delicacy of the subject. If a large edition is required, it will be necessary to have recourse to steel-facing or *aciérage* This consists in depositing on the comparatively soft surface of the copper plate a coating of iron by electrolytic action. A plate so protected will yield an almost unlimited number of prints, as, on the iron face showing the least sign of wear, it can be removed and replaced with a new coating.

Salmon and Garnier, 1855.

The steel-facing, so called (it is really iron only), of engraved plates was invented in 1855 by Messrs. Salmon and Garnier, and to this invention is due much of the popularity of intaglio work, and consequently of the excellence attained to in its various branches. The original cost of intaglio copper plates resulting from handwork only in conjunction with the limited number of prints to be obtained from them without loss

of quality when not steel-faced must of necessity either place prints beyond the reach of the many, or result in their being printed beyond their capabilities.

The process of steel-facing is simple with the proper apparatus at hand, but, if preferred, the work may be entrusted to one of the many firms who make a specialty of steel-facing.

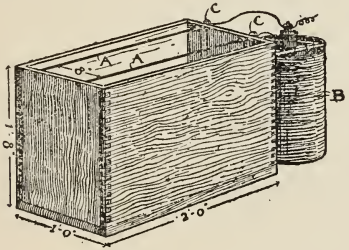


Fig. 8.

Steel-facing trough.

The apparatus required consists—first, of a trough made of wood, and lined with guttapercha, or with a thick coating of pitch, applied hot. The size of the box should be considerably larger than the largest plate to be steel-faced. For plates up to 12in. by 10in., a box of the measurements given in the accompanying sketch will be found suitable.

Two brass rods extend from end to end of the trough, at a distance apart of eight inches; one end of each rod should protrude somewhat beyond the end of the box, and be furnished with a pinching-screw for attaching the wire from the battery.

Anode.

A piece of sheet iron, 22in. by 18in., and a quarter of an inch thick, forms the anode, and is suspended from one of the rods by brass hooks soldered to the back of the plate. The junctions of the hooks with the plates are varnished with several coats of bitumen varnish, but the rest of the plate remains uncovered.

Cathode.

From the second rod is hung the plate to be steel-faced, so that the surface bearing the image is opposite to the front of the anode.

Electrolytic solution.

The solution for the trough is composed of one pound of sal ammoniac to a gallon of water.

Battery.

Any constant current battery will answer this purpose, but I have found the one made by Messrs. Reynolds and Branson most suitable. This consists of a porous pot filled with an acid solution containing a salt of mercury, in which the zinc is inserted

(the presence of this salt renders re-amalgamation of the zincs unnecessary). This pot is surrounded by three carbons, which are inserted in the outer stoneware jar containing a mixture of chromic and sulphuric acids. This battery is perfectly steady and fumeless. Two two-quart cells of this form will produce a sufficient current for the deposition of the iron.

The positive pole (or carbon element) of the battery is connected by means of copper wire with the rod bearing the anode, and the negative pole (or zinc element) with that bearing the plate to be steel-faced.

Saturating solution with iron.

The battery should be coupled up with the trough, and the current allowed to pass through the solution for two days before attempting to steel-face a plate, as the solution must first be saturated with iron. For this purpose a large sheet of unpolished copper must be suspended in the solution from the rod not occupied by the anode, to form a cathode, or receiving plate.

Testing.

After a lapse of two days, test the bath with a clean plate. If a bright clear coating is obtained, the steel-facing may be proceeded with ; but if the coating is porous, or if gas is given off during the operation,

continue the saturating as before. The coating may also present a spongy appearance through *over*-saturation, in which case some of the sal ammoniac should be removed and replaced with fresh.

When the solution in the trough and the current are found to be in order, the photogravure plate may be prepared for steel-facing. A piece of copper wire must first be soldered to the back of the plate of a length sufficient to allow of the plate being suspended in the solution in the trough opposite to the anode. The junction of the wire with the plate should be covered with bitumen varnish, but otherwise the back of the plate need not be protected, as the deposit only takes place on the surface next to the anode.

The process of cleaning the plate is somewhat tedious, as it is absolutely necessary that the surface should be entirely freed from all grease and tarnish or other foreign matter.

Cleaning the plate.

After removing all ink from the plate with turpentine, well brushed over with a somewhat soft nailbrush, the turpentine should be removed with benzole, and the plate rinsed and immersed for half an hour in a

solution of caustic potash one part to twelve parts of water. Then brush with a soft clean brush or a piece of stick covered with several thicknesses of rag, again rinse, and pour over nitric acid of a strength of one part acid to twenty parts of water, rinse and scrub with cotton wool and a paste of whiting, rinse once more, and pour on the acid again, and so alternate the acid and whiting until water will run off the plate quite evenly without signs of greasiness.

Steel facing.

When the plate is quite clean, attach the copper wire to a brass hook, and lower the plate gently into the trough, blowing on the surface of the solution at the same time to drive away any scum which may be present, and which might otherwise become attached to the plate, and with the same object move the plate up and down for a few moments, and then hang the hook on the rod. The plate may be lifted out from time to time and examined, and if the process is going on rightly, it should present the appearance of being coated with matt silver.

An immersion in the trough of half an hour will give a coating that should stand printing for 1,000 or 1,500 copies.

Removing and renewing deposit.

If the coating is in anywise defective, it may be removed in sulphuric acid one part to ten parts of water, and in the same way a steel-faced plate may, on becoming worn, have the coating removed, and a fresh deposit may be made in the manner already described, as though it were being done for the first time.

CHAPTER XIV.

HISTORICAL NOTES.

The first experiments of Nicephore Niépce in connection with photography appear to have been made with a view to obtaining intaglio engraving on pewter, for the printing of music, and there is evidence that as far back as 1813 he made sensitive varnishes, which he spread upon lithographic stones and pewter plates. As an original for copying photographically, he appears first to have used a writing made translucent by waxing; and in 1816 he constructed a camera, or, as he described it in writing to his brother Claude, "a sort of artificial eye, consisting of a square box fitted with an adjustable tube containing a lens." Other letters written during 1816 give his various experiences and his trials of such lens as were available. Although, in writing of his experience with this camera (May 22nd, 1816), he points out that it is possible to obtain results in diffused light, or when the sun is not shining—a ground, he contended, for using the word "photographic" instead of "heliographic"—it is

probable that he was then referring to experiments on chloride of silver paper, and not his work upon metal plates. The earliest recorded success of Niépce in heliographic etching on metal is a portrait of Cardinal d'Amboise, made in 1824 from a print on paper, and now in the Municipal Museum of Chalons-sur-Saone, the native place of this pioneer in photogravure. Particulars and references to original documents will be found in Victor Fouqué's "Vérité sur l'Invention de la Photographie" (Paris, 1867). Schiendl, in his "Geschichte der Photographie" (Hartleben, Vienna, 1891), gives a reproduction of this interesting early specimen. As regards its production, Isidor Niépce writes: "I was a witness of the production of the Cardinal d'Amboise. My father spread upon a polished pewter plate a varnish consisting of Judean pitch dissolved in Dippels oil." The original used in this case was a print which appears to have been rendered transparent by means of wax, and after exposure the bitumen which remained soluble was dissolved away, and the plate was etched. Niépce struggled hard to bring his methods into notice, and in 1827 he brought specimens to England, and

fruitlessly endeavoured to bring the matter before the Royal Society. In 1829 he entered into a partnership for experimental work with Daguerre, but he died two years before the publication of results in 1839, and as Daguerre apparently took but little interest in photo-etching, he gave but little prominence to the experiments of Niépce in this direction.

The daguerreotype image on its silver plate (backed with copper) is of the nature of a weak resist to solvents of the metal, so if the daguerreotype plate is made the anode in an electrolytic cell, or is treated cautiously with a fluid capable of attacking the silver, a shallow but beautifully delicate etched image may be obtained ; but from the point of view of making such methods available for the production of printing surfaces, little else but disappointment attended the efforts of Grove, Fizeau, Donné, and others who worked in the direction between 1840 and 1843. Equally or even more beautiful were Charles Chevalier's electrotype casts of the daguerreotype plate, but, like the etchings, they had neither such depth nor ink-holding roughness as to make them serviceable as printing plates.

A. J. F. Claudet, in the specification of his English patent, No. 9957 of the year 1843, comes nearest to describing a practicable method of etching the daguerreotype plate into an intaglio printing surface. The first etching having been effected, he indicates a method of rebiting, calculated to be specially useful in the case of such shallow plates. The hollows having been filled with a siccative ink, the smooth parts are rubbed clean and electro-gilded. The ink being now removed, the film of gold forms the resist. Claudet, in the same specification (9957, of 1843), indicates the principle of a renewable wearing film, so important in printing from shallow plates. He coated his silver-faced intaglio with a thin film of electrically deposited copper, and when they became worn through in printing, he removed it by diluting nitric acid, or by ammonia.

The founder of that photo-engraving method which has become notably important in recent times is W. H. Fox-Talbot, and in his first patent relating to photo-engraving, No. 565 of the year 1852, he describes a process in which a metal (steel) plate is coated with a thin film of

bichromated gelatine, and when dry the plate is exposed under a transparency. After exposure, the bichromate must be soaked out of the film, which now shows a light brown negative image, and, after drying to lighter parts of the film, will be readily permeable by aqueous liquids, while the shaded parts will be impermeable in proportion to their depth of tint.

Talbot first used a somewhat acid solution of platinic chloride for etching, the percloride of iron (with resinous grain) having been used by him subsequently. The etching fluid was spread over the film by a brush, which in rapidly penetrating the unexposed parts, etched the plate. It is noticeable that although in the specification under notice, Talbot makes no mention of a resinous dust for producing grain, he mentions the lined screen in the form of a piece of folded gauze, the image of which is impressed on the gelatine prior to the image of the object required. A subsequent patent of Talbot's, No. 875 of the year of 1858, brings photogravure quite within the range of easy practice, and Talbot himself produced remarkably five specimens of work. The principal points of difference between the

method of working here described and the method referred to above is that the film is not washed, but as soon as taken from the copying frame is covered with a resinous powder, *e.g.*, copal, this powder being melted by heating the plate. When cold, the plate is etched by a strong solution of perchloride of iron, which readily penetrates those parts of the film which have been protected from light, but fails to penetrate those parts upon which light has fully acted. The same specification describes other methods, one in which the exposed gelatine is partly washed away with warm water, and another in which the plate is first engraved or roughened all over, so that it will print a uniform tint, and upon this is developed a gelatinous relief. The plate now forms an original, from which a mould is taken for electrotypic reproduction.

Talbot in his later work adopted a method of producing a grain by dissolving common resin and camphor in chloroform, and some of this solution being poured over the exposed film, the chloroform evaporates, leaving a film of mixed resin and camphor, when a gentle heat is applied, which causes the camphor to evaporate, and leaves the resin in minute particles.

In the Talbot methods, we have the parent of the method introduced as a secret process about fourteen years ago by the Austrian painter, Klic, and I believe the first specimen of his work shown in this country was a print (portrait of Mungo Ponton) issued with the "Year Book of Photography" for 1882 (published in December, 1881). Although secrecy was imposed upon those instructed by the inventor, details gradually leaked out, and a publication of details in the *Photographische Mitarbeiter*, of Vienna, during 1886, is often referred to as the first printed account given of the method. It is, however, interesting to note that an account of all the essentials of the process appeared on page 67 of the *Photographic News* for 1884, while in the same paper for 1887, page 49, there appeared full and sufficient working details in illustrations of the appliances used, also in the "Year Book of Photography" for 1888, page 171.

The production of intaglio plates by electrotyping from a photographically made mould, or original, has been the basis of numerous processes, and in Charles Chevalier's electrotyping of the daguerreotype image already mentioned we have a

first step in this class of work. It was, however, Paul Pretsch, in Vienna, and A. L. Poitevin, in Paris, about 1853 or 1854, who first successfully made intaglio printing plates by electrotyping on a film of swelled and reticulated bichromated gelatine. Pretsch gave up his appointment in the Austrian Imperial Printing Office in order to exploit his method in England, but his English patent specification of 1854, No. 2373, dated Nov. 9th, is not sufficiently clear in its instructions to be a useful guide to the worker. Pretsch, in works established at Holloway, produced some very fine results, marred, however, by very extensive retouching, which, at that time, was considered necessary to adapt the work to the requirements of the market.

The Photogalvanographic Co. failed commercially, being before its time, and Pretsch returned to Vienna in 1863, a disappointed man, broken down in health, and in 1873 he died.

A portrait of Paul Pretsch, taken by Paul Luckhardt, forms the frontispiece of Ottomar Volkmar's book on "Photogalvanographie" (published by W. Knapp, of Halle a/S., in 1894, price 6m.), a work which

gives historical and practical details of the most important photogalvanographic methods based upon the use of bichromated gelatine, and which may be divided into two classes. The Pretsch methods in which the gelatine is swelled and reticulated by the action of liquids, and methods in which a carbon print or gelatine film developed by hot water on the non-exposed side, are the basis for moulding and electrotyping. Poitevin, of Paris, and Mariot, of Vienna, appear to have been the earliest experimenters in this direction, and, about 1869, portions of a map of Austria-Hungary were produced by such such a method in the Military Survey Department at Vienna. After this the method in its various forms became very general for ordnance map making. A map of Central Europe, consisting of 380 plates, was produced by Mariot's method at Vienna, between 1872 and 1879, and another on a larger scale, of Bosnia and Herzegovina, included 720 sheets, and was in hand between 1872 and 1886. Modifications of Mariot's method have also been extensively used in the survey departments of Prussia, Great Britain, India, Belgium, and other countries. The Mariot method consists in

developing the carbon print upon a silvered copper plate. When dry the surface of the gelatine is made conductive by suitable means, and an electrotype cast is made, this cast being the printing plate.

Major Waterhouse has very materially improved the Mariot process in making it better suited for completely rendering half-tone. As far back as 1878, he published a method of producing grain on the wet carbon print, by treating it—while on the silvered copper plate—with a solution of five parts of tannin in one hundred parts of alcohol, after which it is rinsed, dried, and slightly waterproofed by the application of wax dissolved in turpentine. Plumbago or silver bronze powder is used to make the film conductive (*Photographic News*, 1878, page 380).

Other improvements on this method (a method worked upon by Geymet, Placet, Andra, and others) are due to Waterhouse, and special mention may be made of his plan of graining the wet carbon image by sifting upon it fine sand (slightly waxed on the surface to prevent adhesion), this sand being brushed off when the carbon print is dry (*British Journal of Photography*, 1889,

page 570; *Photographic News*, 1880, page 568).

A photogalvanographic method which yielded excellent results in the hands of Messrs. Goupil, of Paris, under the direction of M. Rousselou, is said to be based upon a suggestion of Mr. Walter B. Woodbury to prepare a thick carbon print or Woodbury relief from a gelatinous mixture containing powdered glass or other rough inert powder. This relief is moulded by pressure against a leaden plate, a reproduction of this leaden plate by electrotyping being the printing surface (*British Journal of Photography*, 1879, page 603).

Numerous processes have been based upon covering the copper plate with an extremely thin layer of bichromated gum, albumen, or other easily soluble substance, which rapidly become insoluble on exposure to light. After exposure under a positive, the etching can be readily effected by a solution of perchloride of iron, whether the non-exposed parts of the film have been previously washed away or not. In recent times, this method has been exemplified in the so-called enameline or "fish glue" process of making relief blocks, and an

original form of it, available for half-tone work on intaglio plates, is that of Mariot, described on page 193 of the *Photographische Correspondenz* for 1881. Sixty-three parts of gum arabic, nine of grape sugar, and twenty-one of bichromate potassium are dissolved in 630 of water, and a copper plate is coated twice, the excess being whirled off by means of the turntable. Exposure is made under a positive, after which the plate is gently warmed, and, when cool, it is etched with perchloride of iron.

A method which stands almost isolated is the photograving method of Obernetter, in which a silver print, the metallic image of which has been converted into chloride of silver, is laid against a copper plate, when the chloride of silver acts on the adjacent copper, while itself reduced to the metallic state (*Photographic News*, 1884, page 67).

There are many methods and modifications not touched upon in this historical summary, but as recent applications of interesting general principles reference may be made to M. Villon's mercurographic methods, and Herr Müller-Jacob's etching methods with resinate colour resists (*Photography Annual* for 1891, page 156-158).

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